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MAMMAL SURVEY

OF

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FINAL REPORT
PITTMAN-ROBERTSON PROJECT 43-R

COMMONWEALTH OF PENNSYLVANIA

JOHN S. FINE, *Governor*

★

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MAMMAL SURVEY

OF

SOUTHEASTERN PENNSYLVANIA

By

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Project Leader

and

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PUBLISHED BY

PENNSYLVANIA GAME COMMISSION

HARRISBURG, PA.

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1952

INTRODUCTION

The survey of the mammals of southeastern Pennsylvania is part of a state-wide survey to obtain practical management information about the mammals of the Commonwealth, with particular reference to their life histories, ecology, range, abundance, habitat preferences, economic importance, and the effects of land use on their populations.

With the completion of this survey and the one conducted concurrently in northeastern Pennsylvania, the field work for the study of the state's mammalian populations will have been concluded. Investigations of the mammals of northwestern, southwestern, north-central, and south-central Pennsylvania (Pittman-Robertson Projects 20-R, 24-R, 37-R, and 38-R) have been completed and the results published.

The last comprehensive study of the mammals of the state, prior to the recent investigations, was made by Samuel N. Rhoads and presented as *Mammals of Pennsylvania and New Jersey*, published in 1903. As there have been great changes in the mammalian fauna since that time, it is sincerely hoped that the information presented herewith will bridge a few of the gaps in our knowledge regarding the wildlife resources of the Commonwealth.

Although this report is based primarily on the field notes of the Project Leader and Assistant Project Leader, everyone associated with the Project has contributed an immeasurable amount of information and much in the way of suggestions. Responsibility for the accuracy of the information included here, and the interpretations given it, are those of the authors, Harvey A. Roberts, Project Leader, and Robert C. Early, Assistant Project Leader.

ACKNOWLEDGMENTS

The Survey of Pennsylvania Mammals (Southeast Sector), Pittman-Robertson Project 43-R, was conducted under the Federal Aid to Wildlife Restoration Act of 1937, and was administered jointly by the Pennsylvania Game Commission and the United States Fish and Wildlife Service.

The entire survey was under the auspices of the Carnegie Museum, which is the depository for all specimens, notes and photographs obtained during this survey.

The Survey of Pennsylvania Mammals was inaugurated through the efforts of Hon. Ross L. Leffler, President of the Pennsylvania Game Commission and Dr. J. Kenneth Doutt, Curator of Mammals, Carnegie Museum, Pittsburgh, Pennsylvania. The work of the Survey was planned and initially supervised by Dr. Doutt in his capacity as Supervisor, Special Personnel. He was also responsible for the taxonomic studies involved.

The Project was under the immediate supervision of the Wildlife Research Division, Pennsylvania Game Commission, and was directed by Mr. Robert D. McDowell, Chief of the Division.

Mr. Neil D. Richmond, Field Supervisor, was responsible for the planning and the coordination of the field work with that of the other parties.

Miss Caroline A. Heppenstall, Assistant Curator of Mammals, Carnegie Museum, supervised the work of the assistants at the Museum, and was responsible for receiving and caring for all specimens and data.

The Project Leader was ably assisted by Robert C. Early, Assistant Project Leader, throughout the entire two year study. Mr. Lorenzo B. Pryor, Research Assistant, Wildlife Research Division, Pennsylvania Game Commission, performed various administrative duties.

The following persons served as part-time laboratory assistants in the food-habit studies, preparation of skeletal material, and related tasks: Messrs. John E. Guilday, A. C. Lloyd, Francis Gabig, Eugene Gettig, Donald Mears and Joseph C. Weimer.

The misses Aenid Horton, Margaret McGregor, and LaVerne Mowry served as stenographers at various periods during the survey.

The writers wish to express their gratitude and indebtedness to all who were directly associated with the Project. Further acknowledgments are certainly due the host of trappers, furbuyers, and landowners who gave freely of their time and facilities as well as supplying us with additional sources of information. The District Game Protectors of the Southeast Division are thanked for their co-operation and assistance.

We wish to express our thanks to the Pennsylvania Department of Internal Affairs, Topographic and Geologic Survey, for permission to use their map of the Physiographic Regions of Pennsylvania.

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AREA AND HISTORY

As used herein, Southeastern Pennsylvania includes the counties of Dauphin, Lebanon, Berks, Schuylkill, Lehigh, Northampton, Lancaster, Bucks, Montgomery, Chester, Delaware, and Philadelphia. It covers an area of approximately 4,905 square miles lying east of the Susquehanna River, west of the Delaware River, north of the Mason-Dixon Line, and south of the northern border of Schuylkill County.

Southeastern Pennsylvania has been under intensive cultivation longer than any other section of the Commonwealth. By 1780, one hundred years after William Penn established his first settlement near the present site of Philadelphia, a major portion of the region lying south of Schuylkill County was relatively well settled and cleared for farming. From that time until the present this region has been one of the most important agricultural areas in eastern United States.

PHYSIOGRAPHY

Physiographically, the region may be divided into four roughly parallel, northeast-southwest trending provinces. These belts, named from northwest to southeast, include portions of the Appalachian Valley Province, the Appalachian Mountain Province, the Piedmont Province, and the Coastal Plain Province, (Fig. 1).

Beginning with the Appalachian Valley Province, we note that it consists of two concentric belts, one the Ridge and Valley Section, and the other the Appalachian Valley Section. Five miles north of Harrisburg the first of the valley ridges, Kittatinny Mountain, is encountered, the general aspect of which is more continuous than any other chain in the Commonwealth. Known by such diverse local names as North Mountain, Blue Mountain, and First Mountain, this range extends through southeastern Pennsylvania from the Susquehanna River to the Delaware River, and in this distance is penetrated only by Swatara Creek, and the Schuylkill and Lehigh Rivers. It is, however, far from being uniform in elevation, varying from 700 to 1600 feet above sea level. From the Kittatinny northward, the country is composed in a great part of high, ragged mountains formed of hard sandstones and quartzite. The intervening valleys, being underlain by more easily eroded shales and limestones, are deep, narrow, and precipitous. For the most part, these high, parallel, even-crested ranges are less distinctly defined than the Kittatinny Mountain, many being crowned by broad, barren, table land. At Bears Head in Schuylkill County, the highest elevation in the entire region is encountered—2,000 feet. Portions of the Southern and Western Middle Anthracite Coal Fields lie within this mountainous terrain. The Appalachian Valley Section, the most southerly division

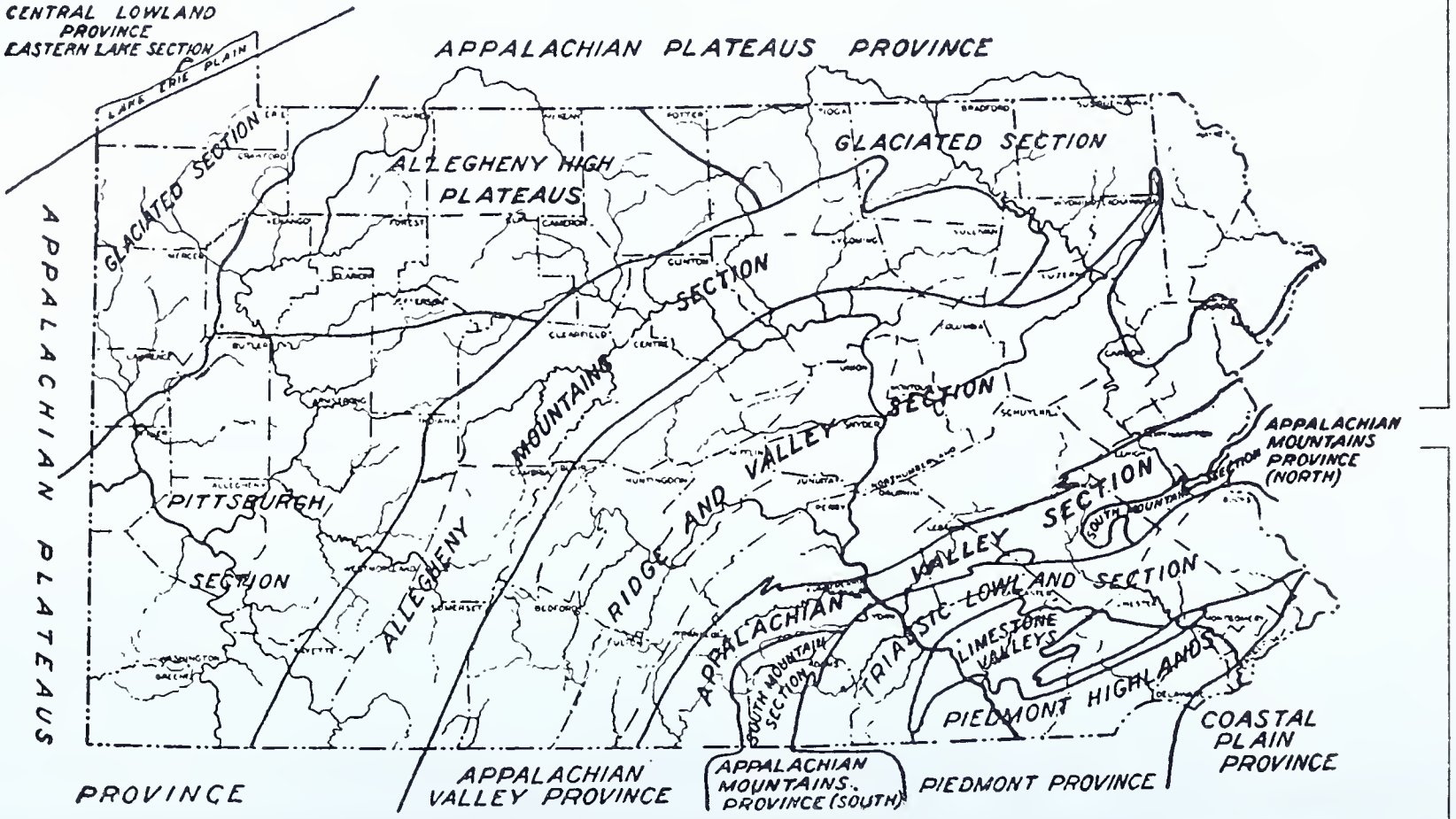

FIG. 1. PHYSIOGRAPHIC DIVISIONS OF PENNSYLVANIA

of the Appalachian Valley Province, is bounded on the north by the Kittatinny Mountain and on the south by the South Mountain. This topographic lowland, consisting of the Lehigh and Lebanon Valleys and termed the Great Valley, stretches as a broad continuous trough from the Delaware River to the Susquehanna River. Although the underlying rocks are not flat-lying, the folds of limestone are so shallow as not to include any of the hard sandstones of the ridges to the north and south. The underlying limestone is therefore easily eroded and has resulted in gentle slopes and slight relief.

Of the four physiographic provinces represented in Southeastern Pennsylvania, the Appalachian Mountain Province, also known as the South Mountains and the Jersey Highlands, is one of the smallest. This upland belt of Triassic crystalline rocks enters the region from the state of New Jersey as a discontinuous and irregular chain. From a height of 800 feet south of Easton, these highlands rise to the southwest; the highest points, near Reading, have elevations of from 1,000 to 1,100 feet. As the surrounding country has an elevation of roughly 400 feet, the relief of this upland seldom exceeds 600 feet. West of Reading and the Schuylkill River this range terminates in a series of isolated hills south of Robesonia, Berks County.

Next in succession, and by far the most extensive, is the Piedmont Province. Its former plateau-like appearance has been modified by prolonged erosion into a generally rolling topography. Immediately adjacent to the Jersey Highlands and the Great Valley lies the Triassic Lowland and Hill Section of the Piedmont. Here the Triassic sandstone and shale form fairly uniform elevations of between 400 and 500 feet; however, this rolling countryside is studded with knob-like hills and low ridges of traprock or diabase. South of this zone the Limestone Valley Section, lying 200 to 300 feet below the hard-rock Triassic uplands, is encountered as the Lancaster Plain and the Chester Valley. In each of these, limestone dominates the underlying rock strata. The third and last division of the Piedmont consists of the Highlands, a region underlain by rocks more resistant to erosion than the limestone to the north. Numerous small streams dissect the area, giving it a rolling, undulating appearance.

Along the Delaware River in the extreme southeastern corner of Pennsylvania is a narrow, crescent-shaped strip that belongs to the Coastal Plain Province. This flat, near-sea-level belt of unconsolidated sands and silts extends from Marcus Hook to Morrisville.

DRAINAGE

Without exception the waters of every spring and brook in southeastern Pennsylvania eventually find their way to the Atlantic Ocean through two of the Commonwealth's three great river systems; namely, the Delaware and the Susquehanna. These two streams, which rise partly outside of the State, act as the east and west boundaries of the region and constitute the principal north-south avenues of drainage. A striking feature of these water courses is the transverse direction of

Fig. 2. Drainage Pattern In Southeastern Pennsylvania

the river valleys to the mountain ranges paralleling the entire northern border of the region. Because both the Susquehanna and the Delaware receive nearly all of their large tributary streams from the west, and because the Susquehanna forms the western boundary, a majority of the larger streams in this section flow into the Delaware (Fig. 2).

The largest river in the State, the Susquehanna, flows south from the extreme northwest corner of the region to its junction with the Juniata River. From this point the general trend is slightly more to the southeast as the river crosses the State boundary and empties into the Chesapeake Bay below Havre de Grace, Maryland. This river is diversified, not only from numerous islands and rocky rapids, but by unequality in breadth. At many places the width of the stream exceeds a mile, but contracts to less than three-quarters of a mile in other places. The Susquehanna is peculiar in the structure of its valley, as exhibited by the wide bottoms of two and sometimes three terraces spreading along the convex sides of the bends.

Progressing from north to south the following major tributary streams drain the western half of the region into the Susquehanna: Mahantango Creek, Swatara Creek, Conestoga Creek, and Pequea Creek. Octoraro Creek, which rises in northern Chester County, flows southward where it enters Maryland and falls into the Susquehanna five miles above Port Deposit. During the last several decades two hydro-electric plants have been built on the Susquehanna; one at Holtwood and the other at Safe Harbor. These plants supply power to cities and towns both in southeastern Pennsylvania and northeastern Maryland.

The Delaware River, entering the region from the north at the Delaware Water Gap and forming the eastern boundary, flows southward to Easton where it receives the Lehigh River. The river's course from this point is generally southeast to tidewater at Morrisville, approximately 150 miles from the sea. At Morrisville the Delaware bends to the southwest, where it is joined at Philadelphia by the Schuylkill River. Another important affluent, Brandywine Creek, flows into the State of Delaware and enters the river near Wilmington. Submergence of the lower Delaware Valley has formed an estuary which allows ocean navigation to reach Philadelphia.

As noted before, the Delaware receives nearly all of its large tributary streams from the west; of these watercourses draining the eastern half of the region, only the Lehigh and Schuylkill rivers are of considerable magnitude. The Lehigh breaks through the Kittatinny Range at the Lehigh Water Gap and flows southwestward to Allentown, Lehigh County, where it turns abruptly eastward until it meets the Delaware at Easton. From the Lehigh Gap to its junction with the Delaware, the Lehigh falls 205 feet in a comparatively short course of 35 miles. The Schuylkill rises in and drains about five-eighths of Schuylkill County, the only county within the region lying in its entirety north of Kittatinny Mountain. This stream passes through the Kittatinny Mountain just north of Hamburg, Berks County, strikes south, and continues through the South Mountain at Reading. After passing the latter range, the Schuylkill winds to the southeast and joins the Delaware below Philadelphia. Its entire length is about 100 miles, 20 miles above and 80 miles below the Kittatinny Range.

Generally speaking, the major drainage is in a southeasterly direction across the region with little regard to geologic structure. Except in the Piedmont, secondary drainage conforms with the east-west underlying rock strata.

SOIL TYPES

As a geognostic rather than a climatic system must be employed to classify the soils in such a comparatively small region as southeastern Pennsylvania, topography, soil texture, and character of parent material prove to be the media for this classification. In the following discussion a soil province is an area having the same general physiography and the same parent rock. Because of an extremely complex geologic structure, more soil provinces are encountered here than in any other sector of the State; however, there is one striking similarity in that most of the soils are distinctively residual. The only "transported" soils occur in the river valleys and on the Coastal Plain. A brief account of the eight soil provinces follows.

Sassafras-Collington Province: This soil area occupies the gently sloping surface of low, eroded terraces extending from the base of the Piedmont across the three to five mile wide Coastal Plain to the Delaware River. Sassafras soils, which predominate, are made up of a wide range of material including sandstone, glacial debris, and shale from the

mountains to the north, and remnants of gneiss, granite, and other igneous and metamorphic rocks from the Piedmont Plateau. This outwash material, deposited as sediment on the sea bottom, has been altered by current and wave action and finally raised above tide level by a geologically recent uplift. The soils have a brown or yellowish-brown surface with a yellowish-brown to reddish-yellow subsoil. As a rule these soils are fairly well drained and are mellow and easily worked.

Chester-Manor Province: The Chester-Manor Province comprises the most extensive and the most important soil series in the Piedmont. It is also known as one of the richest agricultural areas in the United States. The soils are derived from igneous and metamorphic rocks, principally from gneiss and mica schist, with considerable areas of such trap rocks as diabase and basalt. They occupy rolling to hilly country with a few rather rough, broken areas in the Welsh Mountains and the Reading Hills. Chester-Manor soils have grayish-brown loamy surface soils to yellowish-brown to light reddish-brown subsoils. Drainage conditions are usually good, with water percolating readily through the soil mass. Largely because of their topography, the soils wash readily, causing gullying, washing, and sheet erosion. This unfavorable condition is being remedied by contour farming.

Penn-Lansdale Province: The Penn-Lansdale soils extend as a continuous belt of varying width across the northern Piedmont, from the Delaware River to the Susquehanna River. Rocks of sedimentary origin, mainly shales and thin-bedded sandstones, constitute the parent material of these two series. The Penn soils have a reddish-brown to Indian red surface with a dark reddish-brown to Indian red subsoil; the Lansdale soils have a drab, brown or dark gray soil with yellow or mottled subsoil. As noted, both series resemble each other closely in all respects except color. These soils occupy rolling to moderately level areas. Silt loam, which is the leading type in each series, is poorly drained on the more level portions.

Hagerstown-Frederick Province: Hagerstown and Frederick soils occupy a number of areas, the most extensive of which comprises the Great Valley. The next largest area extends across Lancaster County into Berks County, with a spur transecting Chester County from east to west. Hagerstown soils dominate not only the Great Valley but the Lancaster Plain and the Chester Valley. As a result of the solution and weathering of limestone, dolomitic limestone, and some shales, these soils have a yellowish-brown to reddish-brown surface with a yellow or reddish subsoil. The soil mass usually rests on the unchanged limestone rock with little or no partially decayed rock layer between the true soil and the parent material. Gently rolling, rolling, or strongly rolling topography is encountered throughout most of the region. In a majority of cases the water percolates through the soil mass and escapes into underground streams and sink holes.

Muskingum-Lehew Province: Both series are formed from interbedded red and gray shales, and are developed as an irregular linear body along the north side of the Great Valley. The Lehew are shallow soils derived from reddish, thin-bedded shales, while the Muskingum soils are similar

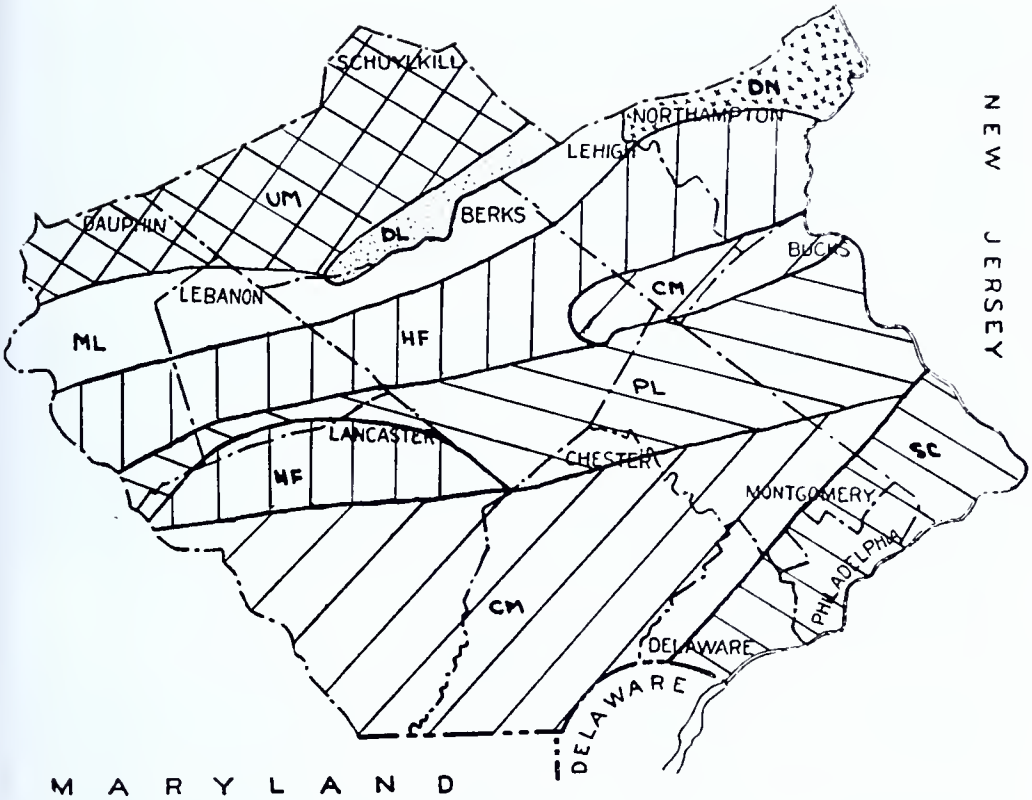

Fig. 3. Major Soil Types

SC.	Sassafras-Collington	DN.	Dutchess-Nassau
CM.	Chester-Manor	ML.	Muskingum-Lehew
HF.	Hagerstown-Frederick	UM.	Upshur-Muskingum
PL.	Penn-Lansdale	DL.	Dekalb-Leetonia

to the Lehew but are developed from gray shales. With the exception of a 3 to 6 inch grayish-brown surface layer the soil has a typical reddish tint. The area, one of varied but not extreme topographic relief, is made up for the most part of mountain flanks dissected in places to a hilly or mountainous terrain. Drainage is usually excessive, especially along the narrow steep-sided valleys. Cultivation is therefore limited largely to the better-drained soils of the stream terraces and mountain benches.

Upshur-Muskingum Province: In topographic position these soils occupy the numerous narrow mountain chains, benches, and ridged valleys of the northern boundary. Alternate thin beds of acid and calcareous shales, as well as gray shales and sandstones of the upper "Coal Measures," are found as the parent material of the Upshur-Muskingum soils. Upshur soils usually have reddish-brown clay loam surface soils and Indian red clay subsoils; Muskingum soils have grayish-brown silty surface soils over yellow-brown subsoils. Magis soil, a complex of the above two soils, is most extensive on the well-defined terraces and at the foot of the mountain slopes. Drainage is normally good on the sandy soils and good to excessive over all of the shale loam.

Dutchess-Cossayuna-Nassau Province: This province occurs in a narrow strip along the southern flank of Kittatinny Mountain and is confined to northern Northampton County. These soils have been derived to a large extent from the weathering and glaciation of blue-gray slate, sandstone, and limestone. The Dutchess soils, with their light brown surface and yellowish-brown to reddish-brown subsoils, predominate and occupy the rolling to ridgy "slate hills." Erosion is generally active on the steeper slopes, especially on the deforested areas adjoining the slate quarries.

Dekalb-Leetonia Province: Throughout southern Schuylkill County these soils are stony, ridgy, mountainous, and in general too steep for cultivated crops. Dekalb soils, which predominate, exhibit a matted layer of organic matter on the surface, followed by a gray to yellow siliceous surface soil and a yellow or yellowish-brown subsoil. They are derived from hard sandstones and thin-bedded platy shales. In the deforested areas erosion is especially active. On the mountain flanks soil material is removed as fast as it forms, leaving rough, stony land as the prevailing type.

CLIMATE

Climatic variation in the region covered by this report is surprisingly great when one considers the fact that only 100 miles separates the southern border from the extreme northern limits. Surface configuration, rather than distance north of the equator, is the climate controlling factor within this sector of the Commonwealth. A succession of east-west trending terraces and peneplanes, increasing in height from near sea level along the lower Delaware River to 2,000 feet in northern Schuylkill County, graphically illustrates the effects of altitude on precipitation and temperature.

Precipitation ranges from 40 to 45 inches over the extreme southeastern corner of the region, due largely to decreased snows of winter and decreased rainfall of midsummer. However, rains of torrential character are not uncommon and have been known to exceed seven inches in 24 hours during the passage of Caribbean storms. These late summer storms rarely extend beyond the Atlantic slope, being blocked by the first ridge of mountains. Over most of the remaining region, annual mean precipitation ranges from 45 to 50 inches. This increase is due to the eastward movement of warm, moisture-laden cyclonic storms. As these storms strike the highlands of central Pennsylvania, they are cooled and give up their moisture in the form of rain or snow over a larger portion of this region. Maximum annual precipitation of from 50 to 55 inches occurs in northern Schuylkill County; minimum precipitation of from 35 to 40 inches occur in western Dauphin County.

As the climate of the Coastal Plain may be termed oceanic, snowfall increases from a minimum annual mean of 25 inches at Philadelphia to a maximum annual mean of 50 inches in the mountainous country of the Appalachian Valley Province to the north and west. Snowfall is

generally confined to the months from November to April, with the heaviest fall usually occurring in late February and early March. Rainfall is well distributed throughout the summer months and droughts of long duration are infrequent.

The mean annual temperature for the region as a whole is 51 degrees F., ranging from 54 degrees on the Coastal Plain to 48 degrees in the mountains of Schuylkill County. Temperatures exceeding 100 degrees F. are infrequent, as are temperatures below zero; however extremes of 108 degrees and –26 degrees have been recorded.

There is roughly a month's difference in the length of the growing season between the northern and southern extremities. The shortest average frost-free season extends over approximately 150 days, or from May 10 to October 10, while the longest ranges from before April 10 until after October 30, or approximately 200 days. For the largest part of the region, the entire Piedmont Province and the Appalachian Valley Section of the Appalachian Valley Province, a 180 day growing season is average.

To summarize, this is a region of long, hot summers, followed by correspondingly mild winters. The warmest months average 70 degrees F. and daytime temperatures during July and August frequently climb above 90 degrees. The winters are mild, with temperatures averaging near the freezing point and often slightly above. Snowfall constitutes only a small portion of the winter's precipitation.

PRINCIPAL FOREST TYPES OF SOUTHEASTERN PENNSYLVANIA

The major forested area of southeastern Pennsylvania lies on the Kittatinny Range, which extends along the northern limit of the study area. It is composed of several parallel mountains which cross northern Dauphin and Lebanon Counties, southern and central Schuylkill County, and the northern borders of Berks, Lehigh, and Northampton Counties.

The chestnut oak type* occupies the dry, rocky crests and southern slopes. This forest type is not of much commercial value. It contains some saw timber and mine timber, but most of the chestnut oak stands are of seedling and sapling size. It is important for the protection it offers watersheds and for the food and cover it furnishes forest game species.

The principal associates on the better sites are red oak, white oak, black oak, scarlet oak, and red maple. A number of other species—black birch, white pine, black gum, hickory, butternut, and sassafras—are minor associates. On the poorer sites red oak, black oak, and scarlet oak are its principal associates, with a scattering of pitch pine, red maple, black birch, and hickory. Sprouting is pronounced in the species associated with this forest type.

* Forest type designations are in accordance with Northeastern Forest Experiment Station, Forest Service, U. S. Department of Agriculture.

On the northern slopes and the foothills of the southern slopes, the red oak-black oak-white oak forest type is dominant. In the past this type was heavily cut and burned, resulting today in young and even-aged woodland. In volume, white oak, red oak, and red maple predominate; black oak, chestnut oak, and hemlock rank second. A large number of other species—principally yellow poplar, white ash, black birch, aspen, and sassafras—appear as minor associates. Non-commercial and shrub layer species are shadbush, witch hazel, gray birch, ironwood and blue beech.

The white pine-hemlock forest type still remains in the cool, moist valleys of the Kittatinny Range and the narrow gaps of the mountains. It exists only in northern Dauphin County and Schuylkill County. The original stands of white pine and hemlock were probably much more extensive than they are today. Heavy cutting and fires have been constantly converting this coniferous mixture to hardwoods. This conversion has gradually reduced the extent of the type until now it is confined to coves, or along streams where the fire hazard is low. Hemlock's affinity for moisture and low temperatures and its inability to withstand droughts are the principal factors that limit its extent to moist bottomlands. Hardwoods associated with this type are black cherry, red oak, basswood, yellow poplar, black birch, yellow birch, white oak and red maple.

The white pine-white oak-red oak forest type is characteristic of the fairly fertile agricultural sections in the rolling foothills of the Kittatinny Range. Again it must be stated that this forest is in very poor condition because of heavy cutting and fires in the past. The type, however, still contains a fair amount of white pine. In volume this tree is the leading species on the better sites, followed by white oak, red oak and red maple. On the less favorable sites white oak is most important, followed by white pine, red oak, hickory and red maple. A large number of other species—white ash, ironwood, aspen, chestnut oak, and black birch—are minor associates. This type is common in northern Dauphin County and in the farming areas of the anthracite region of Schuylkill County.

The scrub oak forest type is a temporary type scattered in northern Dauphin County and quite abundant in the northern portion of Schuylkill County. It is found on dry sites that have been severely and repeatedly burned. It is also common in the strip-mined areas immediately north of the Kittatinny Range in Schuylkill County. Scrub oak (*Quercus ilicifolia*) usually follows after fires that occur in upland oak types. The principal members of the scrub oak type, in addition to this species, are stunted chestnut oak, pitch pine, sweet fern, huckleberries, and blueberries. Pitch pine, the most fire resistant tree in Pennsylvania, often forms an open shelter growth over scrub oak. The aspens also occur locally with this inferior type. The species that most frequently replace scrub oak are sassafras, red maple, chestnut oak and red oak.

The other range of mountains in southeastern Pennsylvania is the South Mountain, which extends from southern Dauphin County, along the southern boundary of Lebanon County, through southern Berks

County, northern Montgomery County and through Bucks County to the Delaware River. Since it is not so high or rugged as the Kittatinny, it supports fewer diversified forest types. Some of the lower ridges have been cleared for agriculture, this woodland is lacking. The high and rocky ridges are covered with the chestnut oak type, with associates of the various oaks and hickories. Mountain laurel, sassafras, and dogwood are frequently in the undergrowth.

In the foothills, the red oak-black oak-white oak type is found and projects into the adjoining farming areas. Yellow poplar, red maple, white ash, black birch, hemlock, and hickories are associate species. Included in the shrub layer are spicebush, dogwood, sassafras, ironwood, and blue beech.

Some of the cooler ravines of the South Mountain support a small acreage of hemlock and white pine.

The forests in the agricultural valleys between the Blue Mountain and South Mountain, and to the south of the latter, appear in the form of woodlots. The farmland that lies in the Lehigh, Lebanon, Schuylkill, Susquehanna, Delaware, Octoraro, Brandywine and Neshaminy valleys is interspersed with woodlots, for the most part well-managed. These woodlots are either of the oak-hickory type or of the red oak-black oak-white oak type. In both, yellow poplar, red maple, black gum, black walnut, and white ash are major associates.

In addition to the above two important types, there is a river and swamp hardwood type that is of no commercial value although it affords an important amount of game cover. It is composed of red birch, black alder, black willow, ash-leaved maple, and sycamore, which occupy the stream banks and adjacent margins of floodplains.

Of botanical interest is the hemlock type situated in the deep ravines cut by tributaries that empty into the Susquehanna River, Octoraro Creek and Brandywine Creek. This type, though typical of more northern latitudes, is common along these streams as far south as the Maryland and Delaware borders. Black birch, yellow poplar, white pine, beech, and red maple are associated with this cover type. Mountain laurel, rhododendron and even evergreen holly are frequently found growing in the shrub layer.

On the periphery of the agricultural valleys, where sub-marginal land has been abandoned, the fields and meadows are being invaded and established with eastern red cedar and occasionally flowering dogwood and sumacs. Especially in southern Lancaster and Chester Counties this successional stage is accompanied by Virginia pine.

Of unique character are the serpentine barrens which traverse southern Lancaster, Chester, and Delaware Counties. These follow low ridges capped with shallow, acid soil. They support an xerophytic forest cover of blackjack oak, post oak, pitch pine, and Virginia pine. Invariably smilax and dwarf blueberries are found in the undergrowth.

The coastal plain of extreme southestern Delaware County is intensively cultivated and supports only a few scattered woodlots and tree species in field borders.

LAND USE

Agriculture: According to Wrigley, this region, exclusive of a comparatively small sector north of the Kittatinny Mountain, lies within the Southeastern Intensive Farming Area. The mountainous terrain of Schuylkill County and northern Dauphin County accordingly lies within the Appalachian Ridge and Valley Farming Area. Inasmuch as the subdivisions of these two farming areas correspond to those of the physiographic provinces, they will be described in the same order, i.e., from northwest to southeast.

The Appalachian Valley Physiographic Province is dominated by a subdivision of the Appalachian Ridge and Valley Area, namely, the General Farming and Local Market Section. As the name implies, general farming is most important, with the production of poultry and vegetables following in the order named. Because of the ruggedness of the terrain, poorer soils, and a shorter growing season, this sector is largely forested and poorer agriculturally than any other in southeastern Pennsylvania. On the other hand, it stands as one of the few great regional strongholds for such forest-loving game species as deer, turkeys, and grouse.

South of the Kittatinny Mountain, the remaining three-quarters of the region is, in the main, intensively farmed. The Great Valley, which comprises the Valley Section of the Appalachian Valley Physiographic Province, has been under cultivation since early Colonial days. Here topography and soil lend themselves to intensive general farming, with the most emphasis being placed on corn production. Such agricultural practices as heavy grazing of woodlots, elimination of fencerows, early spring mowing, and fall disking of corn fields are employed by a majority of farmers, much to the detriment of the small game species. Natural propagation could be greatly enhanced by encouraging more compatible land management practices.

Within the comparatively small Appalachian Mountain Province agriculture is confined to a few limestone-floored valleys where general crops, and dairy cattle are raised. Forests, second only in extent to those north of the Kittatinny Range, occupy the hilly to mountainous topography. Here a variety of small game and an increasing number of deer find ample food and cover.

The northern edge of the Piedmont, or the Triassic Hill and Lowland Section, is one of dairy farming and general crops. A considerable portion of this hilly upland is poorly suited to agriculture, thus patches of woodland are fairly numerous. Immediately to the south, however, in the Limestone Valley Section, 90 percent of the area is in farms (see Table I). Combined favorable climatic, topographic, and edaphic factors for one of the wealthiest and most intensively farmed regions, not only in the Commonwealth, but in the United States. General farming predominates and a four-year system of rotating tobacco, wheat, clover or alfalfa, and corn is commonly followed. Here, as in the Great Valley to the north, the land is so valuable agriculturally that little or no thought is given to the needs of small game. Fencerows have been

replaced by single-strand wire fences, leaving countless acres devoid of cover and native food. At one time this was the heart of the ring-neck pheasant range; but, needless to say, as "clean" farming practices increased the ring-neck population decreased.

Due to the demand for milk by the nearby metropolitan centers, the farmers of the Piedmont Highlands have found it profitable to change from general farming to dairy farming. In an effort to increase production, many farmers have turned heretofore cultivated acres into pasture land, with an end result of increased milk production but decreased small game food. This change in land ultlization is in part reflected in the gradual decrease of rabbits, pheasants, and quail.

Agriculturally, little remains of the Coastal Plain. Urban and industrial sites now occupy most of what was once tidal marshes or productive farmland.

Mining: While anthracite coal is mined to some extent in northern Dauphin County, the largest production centers in the Southern and Western Middle Fields of Schuylkill County. Until rather recently a majority of the coal was obtained by underground tunneling methods. While this type of mining is still carried on, strip or open pit mining has come to the forefront. With the advent of various types of mechanical earth movers, this method often proves the most economical. A century of mining, with its attendant slag dumps, unfilled strip mines, and polluted culm-choked streams, has added little but desolation to the once-beautiful landscape. The cutting of mine props and subsequent unchecked fires have left only a stunted second-growth forest cover over much of the area. Unfortunately, as the cost at present is prohibitive, little has been done in the way of land reclamation.

High grade iron ore has been mined in Southeastern Pennsylvania since pre-Revolutionary War times; however, the development of the Minnesota and Michigan deposits and the difficulties experienced in wresting the metallic substance from the earth led to the gradual abandonment of the industry. Until recently the only major producer was the "pit" workings at Cornwall, Lebanon County. The increased demand for steel and greatly improved mining methods have led to the reopening of iron deposits that were thought to have been "worked out." In the Morgantown area of Lancaster County, several shafts have been driven 1,500 to 3,000 feet below the surface to recover recently discovered deposits that assay at 60 to 70 percent iron content.

Forest Industries: As this region has been under cultivation longer than any other part of the State, most of the valuable timber is now confined to the small woodlots which dot the landscape. A majority of these woodlots are well managed and produce enough timber to be of economic importance. However, most of the lumber is used locally by the farmers to repair or renew barns, tobacco sheds, etc., and little of it is marketed commercially. Forest development in the mountainous areas not suited to agriculture has been retarded and in many places the whole composition has been altered. The early iron-smelting industry exhausted vast tracts in an effort to produce supplies of charcoal for its furnaces. This destructive use of woodland resources persisted until supplies of

anthracite became available. With the advent of coal mining emphasis was shifted from the production of charcoal to mine props and timbers. Today most of the potential saw timber is being sacrificed to meet the constant demand for shoring. The one bright picture to emerge from this wanton waste of one of our valuable natural resources is the subsequent coppice, seedling, and shrub growth that affords a constant supply of food for such game animals as white-tailed deer, cottontail rabbits, and grouse.

TABLE I

PERCENTAGE OF LAND AREA IN FARMS

County	*Total Acreage*	*Acreage in Farms*	*Percentage*
Philadelphia	85,120	30,488	35.8
Delaware	118,400	82,575	68.7
Chester	497,280	423,827	85.2
Dauphin	333,440	214,390	64.3
Lebanon	230,400	173,593	75.3
Berks	553,600	458,450	82.8
Lehigh	220,160	191,650	87.0
Montgomery	309,760	251,751	81.3
Bucks	389,120	352,928	90.7
Northampton	238,080	192,851	81.0
Lancaster	602,240	550,499	91.4
Schuylkill	497,280	216,348	43.5

ECOLOGICAL DISTRIBUTION

The true home of a mammal is the locality where it breeds, and where the surroundings and food are best suited for its existence. Therefore, the distribution of life is dependent, either directly or indirectly, upon climate, the difference in arctic, temperate, and tropical fauna being well known instances. That is to say, one finds definite coexisting species of mammals, birds, and plants within specific regions of suitable climate and environment. Various authors, Merriam, Allen, Shelford, Dice, et al, have used this premise as a basis for separating the continent into numerous zones or regions, each of which marks the northern and southern breeding limits of certain fauna and includes decided changes in flora, climate, and general character of terrain. Because Southeastern Pennsylvania constitutes only a minute segment of the North American Continent, any statements made concerning ecological distribution of mammals must be of necessity applicable to a relatively small area. In short, topographic differences and climatic variations are so slight

within this region as to have an imperceptible effect on distribution. With few exceptions, all species occur where there is suitable habitat, regardless of whether it lies in the northern portion of Schuylkill County or in southern Lancaster County. In an effort to locate this region in the continental picture for the reader, Dr. Merriam's main lines of division and Dr. Allen's nomenclature have been adopted.

Southeastern Pennsylvania lies along the eastern border of temperate continental United States, or well within the Temperate Region. This region, in turn, is divided into several segments designated as Faunas, created when a great many well-marked life forms agree in recognizing a common gographical limit. These Faunas or Faunal Areas may again be divided into Subfaunas, depending of course upon whether or not a species is represented in each Subfauna by a geographical race.

While an arbitrary line drawn along the south flank of Kittatinny Mountain serves to separate the Carolinian Fauna from the Alleghenian Fauna, it must be kept in mind that the boundaries of these faunal areas overlap and are exceedingly broken and irregular.

The terrain south of the aforementioned mountain range is, with the exception of the relatively small South Mountain area, an undulating plain sloping to the southeast. Roughly three-quarters of the entire region lies within this, the Carolinian, faunal area. It consists mainly of an open farming district with interspersed oak-hickory woodlots and small forested zones. While this area has quite a uniform avifauna, its mammalian fauna is not typically Carolinian. The only species found here and apparently absent in the Alleghanian Zone to the north is the Maryland Shrew *(Sorex cinereus fontinalis)*. Ecological niches, such as the cove type forests which cover the steep rocky banks of the lower Delaware and Susquehanna rivers, are strongly reminiscent of the mountain forests of the Alleghanies and provide suitable habitat for the Red-backed Mouse *(Clethrionomys gapperi)* and the Smoky Shrew *(Sorex fumeus)*. Flora and bird life characterizing the lowlands of southeastern Pennsvlyania extend along the valleys between the South Mountain and the Kittatinny range. Some of the species penetrate even farther, following the larger stream valleys. Apparently these valleys afford excellent avenues of egress and ingress from one faunal area to another.

Between Kittatinny Mountains and the northern boundary, the region is supposedly Alleghanian. However, due to the destruction of the forests which formerly covered these mountains, the more characteristic bird and mammals of the Alleghanian Faunal Area have been extirpated. Big-tailed Shrew *(Sorex dispar)* is the one mammal seemingly confined to this area.

In retrospect, the distribution of mammals in southeastern Pennsylvania is by no means confined to faunal areas. Species occur where there is sufficient food and cover; the most suitable localities are much more frequented than those lacking in optimum habitat requirements.

TABLE 2

ECOLOGICAL DISTRIBUTION OF THE MAMMALS

	Forest		*Non-forest*					
	Mesophytic	*Mesophytic-Xerophytic*	*Crop fields*	*Meadow and grassland*	*Abandoned fields: grass-weed stage*	*Abandoned fields: weed-shrub stage*	*Swales and marshes*	*Special factors apparently essential in the habitat, or evident habitat preferences.*
Opossum	x	x	f	f	f	x	f	Preference for bottomland and rocky places.
Eastern Mole	x	x	x	x	x	x	x	Prefers deep, friable soils.
Star-nosed Mole	x	x		x	x	x	x	Mucky soils of poor drainages.
Masked Shrew	x	x	f	x	x	x	x	Sedge-grass meadows preferred.
Smoky Shrew	x	x			f	f		Cool, moist rocky sites.
Little Short-tailed Shrew			x	x				Short grass and weeds.
Short-tailed Shrew	x	x	x	x	x	x	x	Diversified ground cover.
Raccoon	x	x	f	f	f	f	x	Den trees or rock outcrops.
Least Weasel				x	x	x		Open areas and thickets.
New York Weasel	x	x	f	x	x	x	x	Rock tangles, stumps or logs for den sites.
Mink	x	x		f	f	f	x	Prefers watercourses.
Skunk	x	x	f	x	x	x		Prefers forest edge and brushland.
Red Fox	x	x	f	x	x	x	x	Open forest and field preferred.
Gray Fox	x	x	f	f	f	x	f	Heavy brush and woods.
Woodchuck	x	x	x	x	x	x		Herbaceous vegetation.
Chipmunk	x	x			f	x		Presence of stumps, rocks, and brush.
Red Squirrel	f	x				f		Prefers coniferous forest.
Gray Squirrel	x	x	f			f		Mast producing trees.
Southern Flying Squirrel	x	x						Presence of hollow den trees.
White-footed Mouse	x	x	f	f	x	x	f	Wooded or semi-wooded areas.
Prairie Deer Mouse			x	x	f			Sparse vegetation; open shaly hillsides.
Allegheny Wood Rat	x	x						Rock cliffs and talus slopes.
Red-backed Mouse	f	x						Cool, moist, rocky sites.
Meadow Mouse			f	x	x	x	x	Sedge-grass meadows.
Pine Mouse	x	x						Loamy or sandy soils.
Muskrat			f	x	x	x	x	Watercourses.
Woodland Jumping Mouse	x	x						Moist, cool woods.
Meadow Jumping Mouse			x	x	x	x	x	Moist meadow and thicket.
Cottontail Rabbit	f	f	f	x	x	x	x	Herbaceous plants; brush for cover.
Whitetailed Deer	x	x	f	f	f	x	f	Woody browse plants.

x—Indicates usual habitat.
f—Indicates habitats often frequented, but rarely continually inhabited.

METHODS AND PROCEDURES

Field work for this sector was inaugurated on July 1, 1949, and concluded on June 30, 1951. During this period investigations were carried on in ten study areas, chosen on the basis of topography, elevation, native vegetation, land use, and spacing within the assigned sector. Considering the inclusive nature of the work and time limitations, the number of specialized trapping methods that could be effectively employed were

of necessity confined to those producing the largest number of specimens and the widest range of species.

A representative series of mammals from each trapping locality was prepared as study skins, while many others were prepared as skull specimens. In addition to a record of all mammals collected, ecological data as well as notes on daily observations in the field were kept. Parasites, both internal and external, were preserved and await subsequent study by qualified personnel.

The first phase of the winter work was to select two preliminary farm-game predator-prey study areas, a control area in Lancaster County and a study area in Chester County. This work was in preparation for an intensive predator-prey study to be conducted at a later date. Further work entailed an investigation into the species, range, and relative abundance of the mammals occurring within the study and control areas. As part of the winter work trappers and fur buyers were interviewed. A considerable amount of material, including digestive tracts and skeletal material, was obtained from this source.

All material and notes have been deposited in the Section of Mammals, Carnegie Museum, Pittsburgh, Pennsylvania.

Following is a table showing the localities trapped:

LOCALITIES TRAPPED

LEBANON COUNTY:

Trapline Number	*Locality*	*Date*
1	2 mi. NE Mt. Gretna	July 26-30, 1949
2	3 mi. W Mt. Gretna	July 26-31, 1949
3	2 mi. S Mt. Gretna	August 1-4, 1949
4	2 mi. E Lawn	August 1-4, 1949
5	4 mi. SE Mt. Gretna	August 4-8, 1949
6	6½ mi. SE Cornwall	August 4-8, 1949
8	Cornwall	August 9-12, 1949
9	1½ mi. ENE Mt. Gretna	August 15-19, 1949
10	1 mi. SW Mt. Gretna	August 15-19, 1949
11	2 mi. SE Cornwall	August 19-23, 1949
12	1½ mi. SW Mt. Gretna	August 19-23, 1949
13	2½ mi. NE Lawn	August 23-29, 1949
14	1½ mi. SE Cornwall	August 25-29, 1949
15	2 mi. SW Lawn	August 29-September 2, 1949
16	3½ mi. SSE Schaefferstown	September 6-12, 1949

SCHUYLKILL COUNTY:

17	4 mi. SE Pine Grove	September 13-21, 1949
18	3 mi. SE Pine Grove	September 19-23, 1949
19	2 mi. NW Suedberg	September 21-26, 1949
20	4 mi. SSE Tower City	September 26-30, 1949
21	3 mi. SE Tower City	September 26-30, 1949
22	2 mi. SE Tremont	October 3-7, 1949
23	3 mi. W Ravine	October 10-14, 1949
24	1 mi. S Pine Grove	October 12-24, 1949
25	¼ mi. NW Ravine	October 17-24, 1949
26	3 mi. SE Suedberg	October 24-29, 1949
27	5 mi. E Pine Grove	November 10-19, 1949
90	¾ mi. NE Port Clinton	October 16-20, 1950

CHESTER COUNTY:

Trapline Number	*Locality*	*Date*
29	1/4 mi. W Coatesville	January 23-30, 1950
30	2 mi. S Steelville	January 30-February 3, 1950
31	1 mi. N Parksburg	February 6-11, 1950
32	2 mi. N Coatesville	February 6-17, 1950
33	1 mi. S Parksburg	February 14-20, 1950
34	2 mi. SE Downingtown	February 20-27, 1950
35	3½ mi. SE Downingtown	February 20-27, 1950
79	1½ mi. NE West Chester	September 5-9, 1950
80	1 mi. NW Goshenville	September 6-11, 1950
81	1 mi. SW West Chester	September 11-15, 1950
82	3 mi. E West Chester	September 12-16, 1950
84	2 mi. S West Chester	September 19-23, 1950
85	3/4 mi. E Unionville	September 25-29, 1950
86	1 mi. E Unionville	September 25-29, 1950
100	9 mi. SW Oxford	December 13-21, 1950
104	1 mi. N Sylmar	January 16-22, 1951
105	1 mi. SW Glenroy	January 17-22, 1951
106	1 mi. SSW Nottingham	January 22-29, 1951
107	1/4 mi. N Nottingham	January 22-29, 1951
110	1½ mi. SE Nottingham	February 15-21, 1951
111	2 mi. E Chrome	February 26-March 2, 1951

NORTHAMPTON COUNTY:

36	½ mi. N Wind Gap	March 7-20, 1950
38	½ mi. NW Wind Gap	March 14-20, 1950
39	1 mi. N Danielsville	March 20-31, 1950
40	½ mi. NE Wind Gap	March 20-24, 1950
44	1 mi. E Northampton	April 17-22, 1950

LEHIGH COUNTY:

37	2½ mi. S Neffs	March 7-10, 1950
41	3 mi. NW Slatington	March 27-31, 1950
42	3 mi. N Germansville	April 10-15, 1950
43	3 mi. NW Germansville	April 10-15, 1950
45	4 mi. N New Smithville	April 24-28, 1950
46	5 mi. SW Schnecksville	April 25-29, 1950
47	4 mi. SE Slatington	May 1-5, 1950

BUCKS COUNTY:

48	1 mi. SE Point Pleasant	May 9-13, 1950
49	1½ mi. SW Point Pleasant	May 17-21, 1950
50	4 mi. NW Dublin	May 17-22, 1950
51	4 mi. N Point Pleasant	May 22-25, 1950
52	1½ mi. SE Dublin	May 22-25, 1950
53	2 mi. N New Britain	May 24-31, 1950
54	2 mi. N Perkasie	May 24-June 2, 1950
55	½ mi. S Buckingham	June 5-9, 1950
56	1½ mi. N Perkasie	June 6-11, 1950
57	1½ mi. SE Holicong	June 8-14, 1950
58	1 mi. S New Britain	June 12-18, 1950
59	3 mi. SE Furlong	June 15-19, 1950
60	3 mi. NW Ottsville	June 20-24, 1950

MONTGOMERY COUNTY:

74	4 mi. NE Pottstown	August 14-19, 1950

BERKS COUNTY:

Trapline Number	*Locality*	*Date*
61	3 mi. NE Athol	June 26-30, 1950
62	¼ mi. N Athol	July 11-14, 1950
63	½ mi. N Athol	July 17-21, 1950
64	½ mi. SW Athol	July 17-21, 1950
65	½ mi. W Athol	July 18-21, 1950
66	1 mi. S Athol	July 19-24, 1950
67	½ mi. NE Earlville	July 24-26, 1950
68	1½ mi. NE Scarlets Mill	July 26-31, 1950
69	1½ mi. SW Weavertown	July 31-August 4, 1950
70	1½ mi. NE Monocacy	August 1-4, 1950
71	½ mi. N Douglassville	August 7-12, 1950
72	2½ mi. N Monocacy	August 8-12, 1950
73	1 mi. SW Pine Forge	August 14-19, 1950
75	2 mi. NE Earlville	August 21-25, 1950
76	2 mi. SSE Shanesville	August 22-25, 1950
87	2½ mi. NW Lenhartsville	October 2-9, 1950
88	½ mi. N Lenhartsville	October 4-9, 1950
83	2½ mi. N Lenhartsville	October 10-14, 1950
91	½ mi. W Hamburg	October 16-24, 1950
89	2½ mi. N Shartlesville	October 10-14, 1950
92	¼ mi. W Moselem	October 19-23, 1950
93	1 mi. S Virginville	October 23-27, 1950
94	2½ mi. NNW Shartlesville	October 23-27, 1950
95	1 mi. S Eckville	October 24-30, 1950
96	4 mi. SW Eckville	October 30-November 6, 1950
97	1½ mi. NW Kutztown	October 30-November 3, 1950
98	3 mi. NE Hamburg	November 6-13, 1950
99	2½ mi. NW Albany	November 13-17, 1950

DAUPHIN COUNTY:

78	4 mi. S Hummelstown	August 30-September 1, 1950
77	5 mi. S Hummelstown	August 29-September 1, 1950
28	4 mi. NE Harrisburg	December 25-31, 1950

LANCASTER COUNTY:

101	1½ mi. SE Pleasant Grove	January 2-8, 1951
102	2½ mi. SE Wrightsdale	January 9-15, 1951
103	2½ mi. SSE Wrightsdale	January 9-15, 1951
108	½ mi. NE Drumore	January 30-February 5, 1951
109	½ mi. W McSparran	February 6-16, 1951
112	¼ mi. NE Martic Forge	March 6-12, 1951
113	1 mi. N Pequea	March 12-15, 1951
114	½ mi. N Holtwood	March 14-19, 1951
115	1 mi. NW Mt. Nebo	March 19-23, 1951
116	1½ mi. NE Pequea	March 26-April 2, 1951
117	1½ mi. S Mt. Nebo	March 26-30, 1951
118	2 mi. NW Conestoga	April 2-7, 1951
119	2 mi. SSW Mt. Nebo	April 9-13, 1951
120	1 mi. S Mt. Nebo	April 11-13, 1951
121	¼ mi. E Martic Forge	April 16-23, 1951
124	1½ mi. SE Marticville	April 23-27, 1951

DELAWARE COUNTY:

122	½ mi. W Philadelphia Airport, Tinicum Island	April 17-20, 1951
123	1½ mi. N Media	April 17-20, 1951

CHECK LIST OF THE MAMMALS OF SOUTHEASTERN PENNSYLVANIA

The following check list includes all of the species and subspecies of wild and feral mammals, exclusive of aquatic and fossil forms, which have been recorded in southeastern Pennsylvania. Species which were collected or observed during the present survey are not marked; species indicated by an asterisk (*) have been reported, but were not taken by this field party; extinct species are listed at the end. Species indicated by question marks (?) have not been recorded in this area, but occur very close to its boundaries.

Didelphis virginiana virginiana (Kerr) — Virginia Opossum
Scalopus aquaticus aquaticus (Linnaeus) — Naked-tailed Mole
Parascalops breweri (Bachman) — Hairy-tailed Mole*
Condylura cristata (Linnaeus) — Star-nosed Mole
Sorex cinereus cinereus (Kerr) — Masked Shrew*
Sorex cinereus fontinalis (Hollister) — Maryland Shrew
Sorex dispar (Batchelder) — Big-tailed Shrew
Sorex fumeus fumeus (Miller) — Smoky Shrew
Sorex palustris albibarbis (Cope) — White Chinned Water Shrew?
Microsorex hoyi thompsoni (Baird) — Thompson Pigmy Shrew*
Cryptotis parva parva (Say) — Little Short-tailed Shrew
Blarina brevicauda brevicauda (Say) — Large Short-tailed Shrew
Myotis lucifugus lucifugus (LeConte) — Little Brown Bat
Myotis keenii septentrionalis (Trouessart) — Trouessart Bat*
Lasionycteris noctivagans (LeConte) — Silver-haired Bat*
Pipistrellus subflavus subflavus (F. Cuvier) — Georgia Pigmy Bat
Eptesicus fuscus fuscus (Beauvois) — Big Brown Bat
Lasiurus borealis borealis (Muller) — Northern Red Bat*
Lasiurus seminola (Rhoads) — Seminole Bat*
Lasiurus cinereus (Beauvois) — Hoary Bat*
Euractos americanus americanus (Pallas) — Black Bear*
Procyon lotor lotor (Linnaeus) — Eastern Raccoon
Mustela erminea cicognanii (Bonaparte) — Short-tailed Weasel?
Mustela rixosa allegheniensis (Rhoads) — Allegheny Least Weasel?
Mustela frenata noveboracensis (Emmons) — Long-tailed Weasel
Mustela vison vison (Schreber) — Northeastern Mink?
Mustela vison mink (Peale & Beauvois) — Southeastern Mink
Lutra canadensis canadensis (Schreber) — Northeastern Otter?
Lutra canadensis lataxina (F. Cuvier) — Southeastern Otter?
Spilogale putorius (Linnaeus) — Allegheny Spotted Skunk?
Mephitis mephitis nigra (Peale & Beauvois) — Eastern Skunk
Vulpes fulva fulva (Desmarest) — Eastern Red Fox
Urocyon cinereoargenteus cinereoargenteus (Schreber) — Eastern Gray Fox
Canis latrans (Say) — Coyote?
Canis familiaris — Dog
Felis domesticus — House Cat
Lynx rufus rufus (Schreber) — Wild Cat*
Marmota monax monax (Linnaeus) — Southeastern Woodchuck
Tamias striatus fisheri (Howell) — Fisher's Chipmunk
Tamiasciurus hudsonicus loquax (Bangs) — Red Squirrel

Sciurus carolinensis leucotis (Gapper)	Northern Gray Squirrel
Sciurus niger neglectus (Gray)	Northern Fox Squirrel (Poole, 1932) *
Sciurus niger rufiventer (Geoffrey)	Western Fox Squirrel (Introduced) *
Glaucomys volans volans (Linnaeus)	Eastern Flying Squirrel
Glaucomys sabrinus macrotis (Mearns)	Mearn's Flying Squirrel?
Castor canadensis canadensis (Kuhl)	Canadian Beaver*
Peromyscus maniculatus nubiterrae (Rhoads)	Cloudland Deer Mouse?
Peromyscus leucopus noveboracensis (Fischer)	Fisher's Deer Mouse
Oryzomys palustris palustris (Harlan)	Eastern Rice Rat?
Neotoma magister (Baird)	Allegheny Wood Rat
Synaptomys cooperi cooperi (Baird)	Cooper Lemming Mouse?
Clethrionomys gapperi gapperi (Vigors)	Gapper Red-backed Mouse
Clethrionomys gapperi rupicola (Poole)	Poole's Red-backed Mouse
Microtus pennsylvanicus pennsylvanicus (Ord)	Pennsylvania Meadow Mouse
Microtus chrotorrhinus chrotorrhinus (Miller)	Rock Vole?
Pitymys pinetorum scalopsoides (Audubon & Bachman)	Pine Woods Mouse
Ondatra zibethica zibethica (Linnaeus)	Common Muskrat
Ondatra zibethica macrodon (Merriam)	Virginia Muskrat?
Mus musculus musculus (Linnaeus)	House Mouse
Rattus norvegicus (Erxleben)	Norway Rat
Zapus hudsonius hudsonius (Zimmerman)	Hudson Bay Jumping Mouse
Zapus hudsonius americanus (Barton)	Carolina Jumping Mouse
Napaeozapus insignis insignis (Miller)	Woodland Jumping Mouse
Lepus americanus virginianus (Harlan)	Virginia Varying Hare*
Sylvilagus floridanus mallurus (Thomas)	Eastern Cottontail
Sylvilagus floridanus mearnsii (Allen)	Mearn's Cottontail (Introduced)
Sylvilagus floridanus alacer (Bangs)	Oklahoma Cottontail (Introduced)
Lepus sp.?	Western Jack Rabbit (Introduced) *
Lepus europaeus (Pallas)	European Hare (Introduced) *
Odocoileus virginianus virginianus (Boddaert)	Virginia Deer
Odocoileus virginianus borealis (Miller)	Northern White-tailed Deer?

RECENTLY EXTINCT MAMMALS

Martes pennanti pennanti (Erxleben)	Fisher
Canis lupus lycaon (Schreber)	Timber Wolf
Felis concolor couguar (Kerr)	Panther
Cervus canadensis canadensis (Erxleben)	Wapiti or Eastern Elk

DISCUSSION BY SPECIES

Through extensive trapping and field observations a considerable amount of data was compiled concerning the various species of mammals known to occur, or to have occurred within recent times, in this sector of the Commonwealth. With few exceptions the data and discussions contained in the following pages are based on information obtained during two years of study in the field. Life histories, including

species range, habitat preferences, etc., are presented as accurately as our present findings permit.

All breeding data, as well as fall and winter foods of the predatory furbearing mammals, is presented in tabular form in the appendix.

For convenience, the various species of mammals occurring in southeastern Pennsylvania have been grouped under the following headings: Game and Furbearers, Insectivores, Bats, and Non-game Rodents.

GAME AND FURBEARERS

WHITE-TAILED DEER

(Odocoileus virginianus virginianus)
(Odocoileus virginianus borealis)

DISTRIBUTION: Occurs in the wooded portions of every county, including Philadelphia.

HABITAT: Forests, woodlots, tree and shrub thickets on abandoned farmlands, and croplands adjacent to cover.

NOTES: Because most of the southeastern section of the Commonwealth is composed of agricultural land and isolated farm woodlots, it cannot be classified as deer country. The mountainous regions, however, support a large and, for the most part, healthy herd of whitetails. Its population is at the highest in the Kittatinny range, which extends across the northern border of the study area. The northern half of Dauphin County, extreme northern Lebanon County, northwestern border of Berks County, Schuylkill County, and the upper edges of Lehigh and Northampton counties lie within this range.

The South Mountain, which transects the center of the southeastern counties as a discontinuous ridge, offers a relatively small but good habitat for this big game species. In this region the woods are not overbrowsed, and shrubs can reproduce and yet support a shootable population of deer. They confine themselves principally to the forest cover and do only slight damage to the crops on adjoining farms.

Other whitetail territory lies in the wooded and brush-stage areas of southern Lancaster and Chester counties, Delaware County, and along the Delaware River watershed in Bucks, and Northampton counties. The number of deer in these regions has steadily increased over the past decade. The residents consider them as novelties. Even now they constitute a nuisance factor along the highways and, if unchecked, will probably eventually cause crop damage. The physical condition of the whitetailed deer is generally maintained at a high level in this area. This is revealed in the harvest each big game season when fine buck specimens and large antlerless deer are bagged. Does usually bear twin fawns born in the normal period between late May and early July. Because the herd is kept more nearly in balance with the carrying capacity of the range, male antler growth is more normal and few spike bucks are seen.

Table 3 represents the legal deer kill for the 1949 and 1950 seasons in southeastern Pennsylvania.

TABLE 3

LEGAL DEER KILL

1949 and 1950

County	*Antlered*		*Antlerless*	
	1949	*1950**	*1949*	*1950**
Berks	275	92	847	460
Bucks	82	62	89	151
Chester	52	34	41	94
Dauphin	377	161	714	738
Delaware	8	3	7	6
Lancaster	38	18	32	50
Lebanon	185	56	301	259
Lehigh	73	27	92	104
Montgomery	25	17	30	74
Northampton	101	41	163	150
Philadelphia	—	—	—	—
Schuylkill	692	430	1,217	1,119

* Reduced harvest of 1950 a result of poor hunting weather.

BLACK BEAR

(Ursus americanus americanus)

DISTRIBUTION: A rare and infrequent visitor to the Kittatinny range and environs.

HABITAT: Extensively forested areas.

NOTES: An occasional black bear wanders into the mountainous Kittatinny region from the counties to the northeast. From time to time an individual is driven south into this country by forest fires in the primary bear range of the Poconos. During the early period of settlement this large mammal was apparently rather common; however, today the black bear is extremely rare in this sector. As near as can be ascertained, there have been no resident bears in the region for many years.

Poole (1932) states that a black bear was killed in 1855 near Bloody Springs, Bucks County, by a George Degler. Another individual was seen on the farm of John Shaeffer, south-central Schuylkill County, in 1923 or 1924. On June 21, 1930, a bear wandered into the grounds of the Tuberculosis Sanitarium, Hamburg, Berks County. In addition, a number of reports were also received concerning the occasional appearance of bears in northern Dauphin County and Schuylkill County but none were authenticated.

VIRGINIA VARYING HARE: "SNOWSHOE RABBIT"

(Lepus americanus virginianus)

DISTRIBUTION: Former range unknown but probably confined to the Kittatinny range and vicinity. Reintroduced in northern Berks County with little success.

HABITAT: Woodlands and dense swamps of the hilly, mountainous areas.

NOTES: From all indications the snowshoe was extirpated from this region sometime during the middle 1800's. The Pennsylvania Game Commission reintroduced this hare in northern Berks County during 1927 but the experiment proved unsuccessful. Poole (1932) states that three were killed near Pikesville, Berks County, in 1928, and one was killed near the same place in 1929. Another record refers to a snowshoe that was killed near Oley Line, Berks County, during the 1929 season.

This spring a group of sportsmen stocked a number of varying hares in the Pine Swamp area of northern Berks County, but, as yet, it is too early to ascertain the success of the venture. It is the writer's opinion that these releases are doomed to failure largely because of a lack of sufficient suitable habitat.

Ten or twelve years ago jack rabbits *(Lepus* sp.) were introduced in the Kempton area of Berks County, but the species failed to multiply. The last kill was reported from the above area in 1947.

An area south of Hummelstown, Dauphin County, was the locale for a release of European hares *(Lepus europaeus)* during the early 1920's As in the case of the jack rabbit, the species failed to establish itself and, as far as is known, none are extant today.

EASTERN COTTONTAIL RABBIT

(Sylvilagus floridanus mallurus)

DISTRIBUTION: Occurs in all counties of the region.

HABITAT: The cottontail rabbit thrives best in moderately fertile agricultural land that has a diversified habitat of fairly dense grasses, herbs, and scattered clumps of briars and low shrubs. In woodlands it prefers openings created by lumbering operations, where hardwood and conifer slashings furnish cover, while hardwood sprouts, woody vines, and invading herbaceous vegetation provide food. Woodchuck burrows (Gerstell, 1939) and other retreats are important as escape cover in any rabbit habitat.

NOTES: The cottontail is the most sought after game species in southeastern Pennsylvania. It affords recreation during the dog training season, as well as sport and food during the small game hunting season. Its position of importance is reflected by the money expended by the Game Commission, sportsmen clubs, and individuals to increase

the rabbit population. Research projects, live-trapping and transferring, food and cover development, and the farm-game program all aid in improving rabit hunting conditions.

During the course of this survey cottontails were common to locally abundant in suitable habitat in the majority of the counties. However, this game mammal was scarce in Chester, Delaware, and southern Lancaster counties. Apparently foxes, domestic cats, and stray dogs limit the number of rabbits in this region. The rabbit population was observed to be low also in the intensively farmed area of Lancaster County and a small section of southeastern Dauphin County. Here fencerow cover has been removed and very clean cultivation is practiced. While working in these areas with low rabbit populations, very few rabbits were flushed or observed killed on the highways.

In the remaining territory of the Southeast, conditions were more favorable for the existence of rabbits. Berks, most of Dauphin, northern Lancaster, Lebanon, Lehigh, Northampton, Montgomery, Bucks, and Schuylkill counties lie in a good rabbit range. Rabbits were usually plentiful at all seasons of the year, especially in brushy woodlands, moderately cultivated farmlands, marshes, abandoned fields, and orchards with ground cover of herbaceous vegetation. Unlike the northern tier counties, the forests and woodlots of southeastern Pennsylvania support a considerable number of cottontails. In the forests of the northern counties, where over-browsing by deer has eliminated much of the undergrowth, rabbits are practically non-existent. The woodlands of the southeast, with their understory of tree seedlings, shrubs, and woody vines, provide a more advantageous situation for this game species.

During the spring and summer of 1949 and 1950, the weather conditions were favorable for the breeding seasons. At the approach of the hunting seasons, cottontails were generally abundant; however, due to the unseasonably warm weather of the first portion of the small game season, the kill was below the expectations of some hunters. This, in turn, resulted in distributing the rabbit kill more evenly throughout the season.

Specimens Taken: 11—Dauphin 2, Lehigh 2, Lancaster 2, Chester 2, Berks 3.

GRAY SQUIRREL

(Sciurus carolinensis leucotis)

Distribution: Found in all counties of the region.

Habitat: Woodlot and forest dominated by mast producing trees.

Notes: The gray squirrel constitutes one of the most abundant and widely distributed of our small game species. Every woodlot and ridge is well populated with a shootable surplus, and the harvest during the hunting season is, in most cases, quite satisfactory. This squirrel is common not only in the woodlands of the Piedmont and Appalachians but also in the parks of the many urban areas. In their native habitat

squirrels are very wary and hide at the first approach of danger; however, they become quite tame when not disturbed and develop into regular beggars.

As a general rule the gray squirrel builds a nest in some natural cavity in a tree or else constructs a bulky leaf nest in the crotch of a limb. Though diurnal and active throughout the year squirrels spend much of the day in their leafy abodes and usually forage for food during the early morning and late afternoon hours. It is during these periods of greatest activity that the squirrel hunters take their heaviest toll.

Inasmuch as a variety of nuts, fruits, and seeds constitute the squirrel's staff of life, there is a definite correlation between fluctuations of population and mast production. After a year or two of poor mast production squirrels become quite scarce; conversely, a good crop will attract many squirrels from other areas. Such additional food items as young buds and occasional insects and nestling birds are consumed.

Two litters of from three to five are raised each year. A nest of recently born young was noted during the first week in November but apparently this is unusually late for the second litter.

The northern fox squirrel *(Sciurus niger neglectus)* was at one time rather common throughout much of this region; however, this squirrel has apparently been extirpated for many years (Poole, 1944). A number of western fox squirrels *(Sciurus niger rufiventer)* have been introduced east of the Susquehanna River but the species failed to establish itself and the releases have been considered unsuccessful.

Specimens Taken: 15—Berks 3, Schuylkill 8, Dauphin 1, Lancaster 1, Chester 2.

SOUTHERN RED SQUIRREL

(Tamiasciurus hudsonicus loquax)

Distribution: Known to occur in all counties; however, at the present time extremely scarce throughout the entire region.

Habitat: While more numerous in forest compositions dominated by hemlock and white pine, the red squirrel also makes its abode in hardwood areas as well as overgrown fencerows supporting a growth of wild black cherry, sumach, hickory, black locust, and sassafras.

Notes: At present the "piney" is uncommon throughout most of this sector. Over much of the region it is practically non-existent and only a few widely scattered stands of mixed conifers contained an appreciable number. On the basis of interviews with local residents we conclude that the red squirrel has been scarce for the past eight to ten years. Prior to that time practically every woodlot had several inhabitants, and in many cases an isolated clump of trees or a strip of fencerow cover maintained one or more of these animals.

The red squirrel's bill-of-fare includes nuts, fruits, seeds, buds, green twigs, fungi, and, to some extent, insects. As the species is active the year around, a considerable amount of food is stored in hollow trees, woodpecker holes, and under stumps and logs. On occasion the "piney" will pilfer a bird or rabbit nest, killing and partially devouring the young. At times they become rather destructive in orchard areas where quantities of fruit are destroyed in the process of obtaining the seeds. The writers observed a red squirrel plucking pears from a tree and biting away the fleshy portions to get at the seeds. While none of the flesh was consumed, a half a bushel of fruit was destroyed in the process.

Nests, of both the tree-hole and open varieties, are constructed of shredded bark and leaves and are occupied throughout the year.

Specimens Taken: 4—Chester 1, Berks 2, and Lehigh 1.

SOUTHERN WOODCHUCK

(Marmota monax monax)

Distribution: Common to locally abundant in all counties of the region.

Habitat: The open fields, fencerows, and forest edges of rolling hill country are favorite haunts of this species. An interspersion of shrubs, herbaceous weeds, and grasses makes for optimum habitat. Occasionally solitary individuals were noted in densely wooded areas far removed from open crop lands.

Notes: The woodchuck is the largest member of the "squirrel family" in Pennsylvania and occurs rather abundantly over most of this sector. The terrain and cover is so suited to the needs of this animal that the combined effects of small-bore rifle addicts and predation of dogs and foxes fail to deplete the population seriously. In some areas the farmers spend considerable time trying to rid their fields and pastures of this agricultural pest. Immediate results seem to be obtained by plugging all but one entrance to the den and flooding the burrows with carbon monoxide gas. This measure is a temporary one however, especially in areas of high populations. As soon as the resident population is disposed of, individuals from adjacent areas move in and establish themselves.

One of the highest population densities was encountered in Lehigh County, southeast of Slatington, where 39 well used woodchuck burrows were counted in an area of slightly less than four acres. At one time, while making this check, we were able to see 12 "chucks" in front of their dens. The use of these burrows by ringneck pheasants, quail, rabbits, and others as a means of escape from predators and man is well known.

While adapted to life on the ground, woodchucks readily climb trees when other avenues of escape are closed to them. Several times we saw woodchucks climb trees with amazing rapidity when closely pursued by dogs.

Feeding usually takes place during early morning and late evening hours when a wide variety of forage plants such as alfalfa, soybeans, grasses, and clover are eaten. Truck patches and corn fields are sometimes damaged by these rodents. Fat stored duing the summer months affords a reservoir of food for winter hibernation. With the advent of the first killing frost the woodchuck retires to his den where he remains in a dormant condition until late February or early March.

Specimens Taken: 12—Lebanon 4, Dauphin 1, Lehigh 2, Lancaster 2, Berks 2, Chester 1.

EASTERN RACCOON

(Procyon lotor lotor)

Distribution: Common to locally abundant in most counties of the region.

Habitat: The most favored habitats are wooded and semi-wooded areas in close proximity to water.

Notes: Raccoons prefer the vicinity of streams and marshes where they make their homes in hollow trees, hollow logs, and sometimes in fissures in rock outcrops. After spending the daylight hours in a hollow tree or deserted crow's nest, the 'coon forages throughout the night searching for food. His diet is quite similar in many respects to that of the fox, except that in addition to mammalian and avian dietary items the raccoon partakes of a considerable quantity of aquatic food—crayfish, mollusks, fish, etc. Occasionally this diet is supplemented with chickens, ducks, and young turkeys, much to the distress of the poultry raiser.

After a short period of hibernation during the coldest part of the winter, mating usually takes place in February. In late April or early May, 3 to 6 young are born.

Due in part to the low prices paid for long-haired furs, the 'coon has definitely increased during the last fifteen years. This "protection" has permitted an increase in numbers sufficient to constitute a serious predator problem in certain areas. In contrast to many sections of the State, here this animal is hunted chiefly for sport rather than the monetary return from the sale of the pelts; however, with an increased demand for long-haired furs within the past year, trappers have found it profitable to specialize in 'coon trapping. It is hoped that this increased trapping pressure will aid in reducing the amount of predation on small game.

Specimens Taken: 8—Berks 2, Dauphin 1, Lebanon 2, Chester 2, Montgomery 1.

VIRGINIA OPOSSUM

(Didelphis virginiana virginiana)

DISTRIBUTION: Common to abundant in all counties of the region.

HABITAT: Generally distributed in open woods, waste land, and swamps.

NOTES: The opossum is the only marsupial native to North America and it exists in abundance within most of the study area. As this creature is extremely adaptable to the conditions of its environment, it is equally at home in the woodlots and brush lands of the agricultural areas and in the lower elevations of the extensively forested mountainous sections. In a few localities 'possum hunting has a relatively large following, due mainly to the abundance of the species and the frequent captures after short chases. As the climate is temperate in all respects, relatively few adult specimens are subject to the effects of frostbite. Of the numerous individuals examined in the sheds of furbuyers only a few had the frostbitten tails and ears so characteristic in the northern tier counties. In all probability the low price paid for the fur of this animal is reflected in the general abundance of opossums.

Opossums are known to make their nests in hollow logs, beneath rock piles and heaps of debris, natural cavities in trees and rock outcrops, as well as in woodchuck burrows. During the winter this mammal goes into short periods of hibernation to escape the most severe weather.

As an omnivorous feeder the opossum consumes various fruits and berries, young birds and rabbits, insects, mice, snakes, amphibians, and carrion. In one of the localities studied two opossums fed most of the winter on the carcass of a goat that had been discarded in a brushy ravine. Depradations on mammals and birds are confined largely to eggs, nestlings, and very young; however, an over abundance of this animal in areas where there is a concentration of nesting ringneck pheasants or rabbits may prove detrimental.

The young are born after a gestation period of 12 days and crawl into the marsupial pouch where they continue to develop. In about five weeks they become quite active, crawling about their mother's body, and begin to shift for themselves at about two months of age.

SPECIMENS TAKEN: 20—Chester 5, Berks 5, Lebanon 3, Lehigh 2, Dauphin 1, Lancaster 2, Bucks 1, Montgomery 1.

CANADA BEAVER

(Castor canadensis canadensis)

DISTRIBUTION: Formerly throughout the region but now limited to a few widely scattered colonies.

HABITAT: Streams in forest or semi-wooded situations where there is a supply of alders, willows, etc.

NOTES: While not essentially good beaver country, this region supports a few colonies. Other than northern Dauphin, northern

Lebanon, and southern Schuylkill counties few places afford a suitable habitat for beaver. Nevertheless, at one time or another since the species was reintroduced, this valuable furbearer has been a temporary resident of many of the counties south of the mountains (See Table 4). As agriculture is paramount in most of this region, the beaver's presence soon conflicts with man's interests, primarily because of the subsequent damage to crop land and pasture following damming of streams and cutting of trees for food.

At present there is an active colony in the old Delaware Canal near Washington's Crossing, Bucks County, and in the Black Creek area of Schuylkill County. Beaver have been taken in Stony Creek, which transects Dauphin, Lebanon, and Schuylkill counties; in Clark Creek in Dauphin County; in Hay and Maiden Creeks, Berks County; Pennypack Creek, Montgomery County; Octoraro Creek, Chester County; and West Branch of Octoraro Creek, Lancaster County; and probably others.

TABLE 4

BEAVER HARVEST, 1951 TO 1945

	1951	*1950*	*1949*	*1948*	*1947*	*1946*	*1945*
Berks	—	—	—	—	—	—	—
Bucks	4	6	—	—	—	—	—
Chester	—	—	—	—	—	—	1
Delaware	—	—	—	—	—	—	—
Dauphin	—	—	—	1	4	—	—
Lancaster	—	1	—	—	—	2	—
Lebanon	—	—	—	2	2	10	—
Lehigh	—	—	—	—	—	—	—
Montgomery	—	—	1	—	—	—	—
Northampton	—	—	—	—	—	—	—
Philadelphia	—	—	—	—	—	—	—
Schuylkill	1	1	5	5	5	10	8

COMMON MUSKRAT

(Ondatra zibethica zibethica)

DISTRIBUTION: Occurs in every county of the region.

HABITAT: Aquatic specializations limit the muskrat to the vicinity of waterways and impoundments.

NOTES: Since there are few extensive marsh areas or lakes in this region, the muskrat habitat is almost entirely confined to the streams and rivers. For the most part, these slow-flowing, high mud-banked watercourses meet the requirements of the species, and, aside from the fast-flowing, rocky-bedded streams of the wooded mountainous areas, the region as a whole produces a fair number of "rats." A combination of ample habitat and comparatively mild winter weather enables the muskrat to maintain a fairly constant population level.

Even during the state-wide low of 1950, more muskrats were trapped in southeastern Pennsylvania than had been taken for several years previously. The resident population appears to be able to withstand the decimating effects of trapping pressure suprisingly well.

In the marshes and swamps these valuable furbearers build lodges of aquatic vegetation, usually in a rather shallow zone or amidst a clump of emergent shrubby vegetation; however, as habitat of this type is limited, most muskrats live in bank dens. Tunnels are usually dug into a soft, rock-free bank below the surface of the water and terminate in an enlarged chamber well above the water level. Very often a second entrance opens on the bank.

The principal items of food in its diet are bulbs, roots, and stems and foliage of aquatic vegetation. This food is usually taken to a projection of land, stone, or log to be eaten. On occasion, muskrats will travel great distances overland to forage on such tasty morsels as plantain (*Plantago* sp.), apples, corn, and clover. Cattail (*Typha latifolia*), sweet flag (*Acorus calamus*), bur-reeds (*Sparganium* sp.), and three-squares (*Scirpus* sp.) are eaten extensively. Fresh water mussels, fish, and crustacea form a minor portion of the food.

The female has three to four litters each year, the first being born in April or early May. The young number from one to eight with an average of five to six. During a period of a little over a month when the young are confined to the nest, sudden high water is particularly destructive, as are prolonged periods of drought.

Probably the greatest cause of annoyance due to the presence of muskrats is the holes they dig in dams, retaining walls, and the banks of farm ponds, which lead to leaks and subsequent draining.

SPECIMENS TAKEN: 35—Schuylkill 2, Berks 2, Chester 28, Lancaster 1, Dauphin 1, Lehigh 1.

EASTERN SKUNK

(Mephitis mephitis nigra)

DISTRIBUTION: Occurs in all counties of the region.

HABITAT: The skunk enjoys a wide range of habitat, but prefers an interspersion of woods, fields, meadows, and bushland. Extensively forested mountainous regions are shunned and the species is rather uncommon in such situations.

NOTES: Until the early 1940's, the skunk was rather abundant in most of southeastern Pennsylvania; however, about 1942 there was a marked decrease in the population as the result of an unidentified epizootic. In some areas the skunk has made a rapid recovery and for the entire area this furbearer is now classified as common. Like many other species the density of population exhibits a marked variation from one locality to another.

The skunk is occasionally encountered in daylight about clearings, pastures, or borders of woodlots digging and rooting about under the sod for grubs and insects. Its food consists of crickets, grasshoppers, larvae, grubs, mice, frogs, carrion, crayfish, eggs, and small mammals and birds. Carrion is one of the chief items on the bill-of-fare; and mice including the young in the nests, are also of major dietary importance. Although eggs are eaten, the destruction of nests by the skunk is often overemphasized.

The young are usually born during May in a deserted woodchuck burrow or some grass-lined cavity. An exception to the usual May birth was noted in Lebanon County when a nest of new-born skunks was found during late July. There seems to be a considerable variance in the size of the litters, but the average number appears to be six. Extremes of two and fourteen have been recorded.

As a furbearer in this region the skunk is second only to the muskrat in importance. The value of the skunk's pelt has risen in recent years and furbuyers report an increased number of hides offered for sale. Animals with a brownish pelage are not particularly uncommon in this region, particularly in the area within fifty miles of Philadelphia. On the average, furbuyers receive one skunk with this peculiar color phase for every 100 black individuals.

Specimens Taken: 10—Dauphin 1, Lebanon 2, Chester 2, Lancaster 1, Berks 2, Bucks 1, Lehigh 1.

SOUTHEASTERN MINK

(Mustela vison mink)

Distribution: Formerly quite common and occurred in all counties of the region. Today, however, the mink is generally scarce throughout much of its former range and is only occasionally taken by trappers.

Habitat: From the tidal creeks of the lower Delaware River to the upland woods of the Kittatinny range, mink occupy diverse habitats. This valuable furbearer exhibits a definite preference for stream margins and seldom does it wander far from water.

Notes: The mink is a tireless wanderer and ranges over a large territory following the regional watercourses. Along this route a den is constructed under the bank of some stream where there is an exposed tangle of roots or rocks. At times natural cavities and muskrat burrows are utilized.

Little need be said concerning the economic importance of this animal because of its scarcity in this region. The horde of trappers afield each season, who catch a considerable number of furbearers, catch no mink. Most furbuyers receive only a few each season, and some, none at all. Mink seem to be most common in the Brandywine drainage of Chester County and in the northern half of Berks County.

While this Mustelid obtains a portion of its food from the water in the form of fish, frogs, crayfish, and aquatic insects, it also frequents the stream banks in search of sustenance. Here it captures mice, ribbits, muskrats, and birds, apparently often killing for the sheer love of the act.

Mating takes place in late February or early March and the young are born in mid-April. The mink has 5 or 6 young in the average litter, the number varying from 4 to 8.

SPECIMENS TAKEN: 4—Chester 4.

NEW YORK OR COMMON WEASEL

(Mustela frenata noveboracensis)

DISTRIBUTION: Occurs in all counties, although it is scarce in Delaware and Philadelphia counties.

HABITAT: The weasel prefers forest edges, brushy fields, marshes, and farm woodlands. It is most common in habitat that offers an abundance of prey species and suitable cover for dens, such as brush piles, stone fences, rock piles, and other retreats.

NOTES: The weasel population is highest in the relatively rugged sections of Schuylkill and Berks counties. It is common to locally abundant in portions of other counties through which the Kittatinny and South mountains extend. Abandoned farmlands and "barrens" also support fair numbers, especially in southern Lancaster County, Chester County, and Bucks County. Intensively farmed areas, which provide little or no cover for microtine species, invariably support very few weasels. Food habit studies have revealed that mice make up the major share of this carnivore's diet, and the weasel's abundance usually is in direct proportion to the mouse population. During this survey no complaints were received from farmers or poultrymen of domestic fowl being killed or eggs destroyed by weasels.

The New York weasel normally sheds its brown summer coat for a white one in the northern part of its range. In southeastern Pennsylvania white weasels or "ermine" are very rare. A specimen which exhibited signs of changing from white to brown pelage, was collected on a highway in Lehigh County on April 14, 1950, and one other all-white weasel was seen from Delaware County.

No Bonaparte weasels *(Mustela erminea cicognanii)* or least weasels *(Mustela rixosa allegheniensis)* were collected during the two-year study. It is doubtful whether the former occurs in this section; however, there is a reported record of the least weasel's occurrence in northern Dauphin County (Luttringer 1931).

SPECIMENS TAKEN: 10—Schuylkill 2, Dauphin 1, Chester 6, Berks 1.

NORTHEASTERN OTTER

(Lutra canadensis canadensis)

DISTRIBUTION: Formerly found along the major watercourses; today no otters are known to occur in the region.

HABITAT: Lakes and margins of larger streams.

NOTES: According to the residents of the lower Susquehanna Valley, many of whom were once commercial shad fishermen, otters were occasionally noted along the lower reaches of the Susquehanna River. Apparently the abundance of shad afforded an ample supply of food. With the advent of the hydro-electric dams the annual run of shad stopped and the otter disappeared. While otters are known to occur to the north and south of this region we have no knowledge of any transient individuals having been recorded since 1923.

A reliable observer and a man who has spent seventy-five years along the Susquehanna River, Mr. A. R. Neff, of Pequea, Lancaster County, relates that he observed a large adult otter along the Lancaster County shore, between Colly's Run and Cold Cave, during the early fall of 1923.

EASTERN RED FOX

(Vulpes fulva)

DISTRIBUTION: Occurs in every county of the region.

HABITAT: Rolling agricultural sections where there is an interspersion of brushy lands, woodlots, and open fields.

NOTES: The red fox, according to early records, was originally extremely rare throughout the woodlands of southeastern Pennsylvania. Only to the north and northwest in New York State and New England was this species at all plentiful, especially in the open glade areas. To the south in Maryland and Virginia the same condition existed as in this section of the State. Volumes could be written concerning the genetic background of the resident fox, but, in a few words, it seems probable that our present Reynard is the product of cross-breeding between the native red fox and the European red fox *(Vulpes fulva fulva)*, introduced in the middle of the 18th century for hunting purposes.

As the forests were removed to make way for farm land the red fox began to increase in numbers. This increase in population was constantly augmented by the liberation of European foxes and the subsequent cross-breeding that took place. Today this fox is generally common to abundant throughout this sector of the Commonwealth.

A fox's home range covers an area of about five square miles; scarcity of food and the demands of the pups often necessitate a wider range. When hunted, a red fox likes open, cross-country running, often taking

a pack of pursuing hounds five, ten, or more miles in a straight line before doubling back. If necessary, a fox will cover 20 to 30 miles in the course of a chase. In this respect the red fox far excels its gray cousin. Dens are usually located underground and are, in most cases, the enlarged dens of woodchucks. These dens are located in a variety of sites that include open fields, fencerows, edges of woods or brush next to fields, and sometimes within large wooded areas.

The diet of the red fox varies according to season and depends largely on what food can be obtained most readily. In general, its basic rations include mice, muskrats, squirrels, rabbits, game birds and passerines, domestic fowl, insects, and fleshy fruits. Eggs of birds, snakes, and turtles are also consumed. With insufficient knowledge concerning the feeding habits of the red fox, the small game hunters brand this animal the scourge of the countryside; on the other hand, the fox hunting clan has nothing but praise for the red fox. Needless to say, a high concentration of red foxes, or any other predator, in any one area is likely to be detrimental to small game.

Foxes are monogamous and mating covers a period of about six weeks, beginning in December and ending in early February. After a gestation period of 51 days the young are born deep in the recesses of an underground den. The size of the litter averages from 4 to 8, occasionally exceeding ten in number. At the time of birth the vixen drives the dog-fox out and he usually busies himself with bringing food to the entrance of the den. The pups beging to take solid food at about six weeks and they leave the den by the middle of June or early July.

Under normal conditions, fox mortality as a result of disease, is insignificant. Possibly as the result of the practice of releasing pen-held and pen-raised foxes to supplement the supply of wild foxes in hunting communities, sarcoptic mange has been introduced and has become a mortality factor of major importance. Its high degree of contagion is borne out by the fact that following an epidemic of sarcoptic mange the red fox population is often decimated. Mange is caused by a small mite, *Sarcoptes scabei,* that burrows beneath the skin and secretes an irritating poison. The head and feet of the fox are usually affected first, followed by the loss of hair on other parts of the body. On several occasions the writers examined diseased individuals which were almost completely devoid of hair. This infectious disease is easily transmitted from one individual to another, especially during population highs and warm weather. Mange cases increase from January to a peak in September, then decrease until a low is again reached in January. The disease in itself is ordinarily not fatal to adults, but it may reduce the vitality to such an extent that the fox easily succumbs to various secondary infections. From October 1946 through March 1949, 2,779 red foxes were probated for bounty from southeastern Pennsylvania, and of these a total of 57 were infected with mange (See Table 5).

TABLE 5

MANGE CASES IN RED FOX

OCTOBER 1946 THROUGH MARCH 1949

County	*Total Foxes Examined*	*Total Mange Cases*	*Land Area Per Sq. Mi.*	*Foxes Killed Per Sq. Mi.*	*Mange Per Sq. Mi.*
Berks	585	16	864	.67	.019
Bucks	309	3	617	.50	.005
Dauphin	302	1	520	.58	.002
Lancaster	370	28	945	.39	.030
Lebanon	180	2	363	.49	.006
Lehigh	306	0	347	.90	.000
Montgomery	112	2	484	.23	.004
Northampton	180	2	274	.48	.005
Schuylkill	435	3	783	.55	.004

Note: No bounty paid on red foxes from Chester, Philadelphia, and Delaware counties.

SPECIMENS TAKEN: 8—Chester 2, Berks 3, Lancaster 2, Lehigh 1, Dauphin 2.

EASTERN GRAY FOX

(Urocyon cinereoargenteus cinereoargenteus)

DISTRIBUTION: Occurs in every county.

HABITAT: While the range of the red and gray fox overlap, the latter species shows a greater preference for forested and brushy regions.

NOTES: Unlike its red cousin, the gray fox was a common resident of southeastern Pennsylvania prior to the coming of the first white man. Today, as in the past, it enjoys universal distribution in wooded areas, swamps, and sub-marginal land.

The gray fox as a sporting animal is far excelled by the red. Fox hunters concur that for a long, hard chase the gray is greatly inferior. So strong is the urge to "tree" or "go to ground" that the gray seldom gives the hounds a prolonged run. Only during the mating season when the parental instinct may seek to guide the pursuers out of the country or when it is in tangled swampy areas will the gray fox afford an accountable chase.

As gray foxes are not so warmly clad as the red foxes they prefer warmer sleeping quarters, where they await the passing of the more severe winter weather. A pile of field stones, a natural rock cavity, or a rooty tangle may provide a den site, and in this region woodchuck burrows are often appropriated. The species is said to utilize hollow logs (Hamilton 1943) but we were unable to find evidence of this during the course of the survey. The most significant difference in the denning habits of the two foxes is that the gray prefers more ground and overhead cover at the den site.

In this region the gray fox is equally as destructive as the red fox; however, while the constituents of the diet are essentially the same there is some variance in the total consumption of several items. Even with the limited amount of time that could be devoted to the feeding habits of foxes, we found that the naturally aggressive red fox was more destructive to poultry than the gray. On the other hand, rabbits occurred as a food item more often in the gray fox's bill-of-fare. The consumption of the following food items by the gray fox is considered harmful; ringneck pheasants, passerines, rabbits, poultry, gray squirrels, and muskrats. The killing and eating of insects, various weedy fruits, mice, rats, weasels, and snakes, is considered beneficial.

In the home den the vixen raises a litter of 4 to 6 young which are born in April or early May. The period of gestation is approximately 60 days or roughly nine days longer than that for the red fox. At about four weeks of age the young first venture from the den and at about five weeks begin to take solid food. The pups leave the den about the middle of July, and by early September they are completely divorced from their parents.

During the two years in the field we received no reports of mangy gray foxes nor were any mange cases noted in the gray foxes probated for bounty from this region. This species is possibly free from the disease chiefly because no pen-reared or pen-held gray foxes are released for hunting purposes.

Specimens Taken: 8—Chester 4, Lancaster 1, Berks 2, and Lebanon 1.

EASTERN BOBCAT

(Lynx rufus rufus)

Distribution: An infrequent resident of the more rugged and isolated zones of the Kittatinny and South Mountain ranges.

Habitat: Confined to the inaccessible rock outcrops and ledges of the heavily wooded mountainous regions.

Notes: Since no bounty has been paid on the bobcat since 1938 and prior to that time all skins probated for bounty were listed under the county residence of the claimant rather than the county of kill, accurate records are hard to obtain. Poole (1932) states his investigations revealed that prior to 1860 this cat was not at all uncommon in Berks County. By the turn of the century the population had dwindled to a few scattered individuals. The last kill Poole records, exclusive of bounty records, was made in 1924 near the border of Berks and Lehigh counties. Sight records are favorite topics of discussion and invariably come to light wherever a group of hunters gather. Most of these stories, however, are the products of vivid imaginations. Doubtlessly a few

bobcats still inhabit the mountainous zones, as wandering individuals continue to drift into this region from the Poconos to the north

In addition to the Berks County records we received believable reports of bobcats in the Black Creek and Pine Grove areas of Schuylkill County as well as in the Peter's Mountain and Mahantango Mountain areas of northern Dauphin County.

While this secretive creature may have at one time been detrimental to both large and small game populations, it is no longer present in sufficient numbers to warrant extirpation.

INSECTIVORES

COMMON OR EASTERN MOLE

(Scalopus aquaticus aquaticus)

DISTRIBUTION: Occurs throughout the entire region and is generally known as the "common ground mole".

HABITAT: While this mole may be found in all but the wettest habitat it exhibits a marked preference for loamy, rock-free, well-drained soils.

NOTES: This naked-tailed mole may be found in both forested and non-forest areas, occurring wherever soil conditions are conducive to extensive burrowing. Its surface tunnels are, much to the despair of greenkeepers and gardeners, common sights in lawns, gardens, and golf courses. A common fallacy concerning the feeding habits of this mole deals with its ability to consume large amounts of grass roots. As proof of this statement people merely point to the streaks of dead grass that appear in their lawns during the dry, summer months. In reality, the moles tunneling activity near the surface separates the grass roots from the earth below. As a result the grass becomes unrooted and soon dies from lack of moisture and food. *Scalopus* feeds extensively on insects, insect larvae, and earthworms.

Sandy silt, deposited as alluvium along the flood plains of our regional streams, affords optimum habitat for this burrowing creature. Sudden flash floods and heavy rains occasionally inundate the network of tunnels, forcing the mole to the surface where it becomes easy prey for foxes, owls, and cats. While this mole is often killed by cats and foxes the sharp musky odor emanating from glands at the base of the tail apparently render it unpalatable.

Breeding data is available only for one specimen; a female taken on May 25, 1950, contained four placental scars and was lactating.

SPECIMENS TAKEN: 6—Bucks 3, Dauphin 1, Schuylkill 1, Berks 1.

STAR-NOSED MOLE

(Condylura cristata)

DISTRIBUTION: Occurs locally throughout all counties of the region.

HABITAT: Confined to the mucky soils of wet bottomlands, seepage areas, abandoned river dams, and reservoirs.

NOTES: This mole favors situations where the soil is extremely moist or well-saturated with water. The mucky soils found in zones of emergent vegetation that surround reservoirs and farm ponds appear to be particularly attractive. Numerous "breathing holes" or "pushups" that are attributed to crayfish are often indications of star-nosed mole activity. On two different occasions during the dry month of August, 1950, we caught star-nosed moles as they scurried across a macadam highway. As the ground for a great distance on either side of the road was sunbaked hardpan these moles were apparently migrating from a locality that was no longer tenable to one meeting their requirements.

Star-nosed moles are active throughout the year and only prolonged periods of freezing weather drive them below the frost line. An indication that it leads at least a semi-aquatic existence is borne out by the fact that trappers occasionally catch this mole in traps set for muskrats several inches below the surface of the water.

No breeding data was obtained for this species.

SPECIMENS TAKEN: 4—Berks 2, Delaware 1, Schuylkill 1.

MARYLAND SHREW

(Sorex cinereus fontinalis)

DISTRIBUTION: Probably found in every county of the region.

HABITAT: Inhabits all types of habitat during cyclic highs.

NOTES: Dr. J. Kenneth Doutt, Curator, Section of Mammals, Carnegie Museum, Pittsburgh, Pennsylvania, classified all of the *Sorex cinereus* taken in this region as belonging to the sub-species *fontinalis*. In the mountainous country they approach *cinereus cinereus* while in the lowlands they closely resemble typical *fontinalis*. A large number of the specimens were apparently collected from the zone of integradation, thus some individual specimens are extremely hard to identify.

This tiny shrew was relatively scarce over much of its range from July, 1949 to August, 1950, especially in the mountainous sections. However, during the fall and winter months of 1950-1951 there appeared to be a sudden increase in the population of the Piedmont Highlands and specimens were taken in many localities that previously proved unproductive. This phenomenon was particularly noticeable in lower Chester

County when seventy-eight specimens were taken in about two months time. The year previously, the same area produced but three specimens in the same length of time.

During a population high the species is not confined to a specific habitat, but seems to be at home in moist woodland, dry fallow fields, and marshy meadows. While generally distributed, during the winter of 1950-1951 larger concentrations were noted in moist sedge-grass meadows where they utilized the runways of meadow mice. Nests are tiny affairs constructed of leaves and grasses and placed beneath a clump of roots, log, or stump. Several nests that were used by this shrew appeared to be reconditioned nests of the white-footed mouse. The nesting cavity was lined with finely shredded blackberry leaves.

The food of the Maryland shrew is similar to that of the other *Soricidae* and includes insects, insect larvae, annelids, and the dead bodies of other small mammals. Captive *fontinalis* feed on the carcasses of meadow mice always commenced their feeding at the genital areas and worked forward into the viscera.

Males in breeding condition appear in late February and apparently females become receptive during this period. The earliest and latest dates that gravid females were examined were March 28 and September 26, respectively. Litters range in size from 4 to 6 with 5 being the average number.

SPECIMENS TAKEN: 123—Lebanon 1, Lancaster 63, Schuylkill 10, Chester 44, Lehigh 2, Delaware 3.

BIG-TAILED SHREW

(Sorex dispar)

DISTRIBUTION: Apparently restricted to the Kittatinny range and the mountains to the north.

HABITAT: Cool, moist crevices between rocks and boulders in deciduous and mixed deciduous-coniferous woodlands.

NOTES: The favorite haunts of this shrew appear to be the labyrinth of subterranean passages that honeycomb the rock and boulder tangles of the higher mountain elevations; all specimens taken were at elevations ranging from 1,200 to 1,300 feet above sea level. In such cool, dark situations mosses, lichens, and ferns often cover the boulders and, while there is little soil, an accumulation of leafmold and humus litters the recesses between the jumbled rocks.

In three of the four localities producing this shrew, the forest composition of chestnut oak *(Quercus montana)*, black oak *(Quercus velutina)*, and black birch *(Betula lenta)* was stunted and of poor quality, as was the understory of witch hazel *(Hamamelis virginiana)*, blueberries (*Vaccinium* sp.), mountain laurel *(Kalmia latifolia)*, and round-leaved dogwood *(Cornus circinata)*. Trapping was carried out in these rocky, mountain saddles during early March when there was considerable moisture in the ground. During the late summer these situations lose

much of their moisture and possibly become untenable for the big-tailed shrew. If this is the case there must be a limited amount of seasonal migration taking place.

The remaining locality supported a mature forest growth of yellow birch *(Betula lutea)*, tulip poplar *(Liriodendron tulipifera)*, red maple *(Acer rubrum)*, and hemlock *(Tsuga canadensis)* with a dense understory of mountain laurel, rhododendron *(Rhododendron maximum)*, and witch hazel. This cover afforded considerable shade throughout the entire length of a steep rocky ravine. Associated with the *dispar* in all localities were two other shrews, *Sorex fumeus* and *Blarina;* also present was the red-backed mouse *(Clethrionomys)*.

Similar habitats were trapped in the South Mountains and the cool ravines of the lower Susquehanna Valley with negative results. As far as can be ascertained the Kittatinny range marks the southern limit of the big-tailed shrew in this region.

Specimens Taken: 4—Northampton 3, Berks 1.

SMOKY SHREW

(Sorex fumeus fumeus)

Distribution: Occurs in the wooded mountainous terrain of the northern half of the region.

Habitat: Shady, damp coniferous and hardwood forests of rocky ravines and talus slopes appear to be optimum habitat. Extensive trapping in dry woods produced few specimens while crop lands and meadows gave negative results.

Notes: Moss-covered boulders and decaying logs, shaded by a canopy of conifers or hardwoods appear to be the favorite haunts of this shrew. The labyrinth of passageways found beneath rock jumbles, rotting logs, and deep leaf-mold are most commonly frequented. Burrows are constructed to a limited extent; however, the tunnels of other small mammals and natural passageways are utilized whenever possible. Living in company with the smoky shrew are the red-backed mouse, short-tailed shrew, white-footed mouse, and occasionally the masked, and big-tailed shrew. Despite seeming scarcity at some seasons, local population eruptions are not uncommon. At Wind Gap, Northampton County, we took 25 specimens on one trap line in 700 trap nights.

This insectivore appears to reach its southern limits in this section of Pennsylvania at the following stations: 1½ mile S Mt. Nebo, Lancaster County; 1½ mile NE Scarlets Mill, Berks County; and 4 mile N. Point Pleasant, Bucks County.

Breeding data is available for the months of March, April, May, June, and July. Male specimens taken during the early part of March appeared to be in breeding condition; gravid females were noted from April to July with the average size of the litter being six.

Specimens Taken: 71—Lebanon 1, Lancaster 3, Schuylkill 6, Chester 4, Northampton 44, Lehigh 1, Bucks 2, Berks 10.

LITTLE SHORT-TAILED SHREW

(Cryptotis parva parva)

DISTRIBUTION: Probably occurs in limited numbers throughout the entire region.

HABITAT: All specimens were trapped on dry shaly uplands, devoid of all but scattered shrubs and sparse ground cover.

NOTES: An insufficient number of specimens were trapped to establish any definite habitat limitations. In all, 16 *Cryptotis* were taken; of this number 14 came from abandoned fields situated on a bluff overlooking the Schuylkill River. This locality supported a uniformly sparse ground cover of weeds and grasses. Wild strawberry *(Fragaris virginiana)*, asters *(Aster spp.)*, yarrow *(Achillea millefolium)*, goldenrod *(Solidago spp.)*, broomsedge *(Andropogon virginicum)*, and rabbit-foot clover *(Trifolium arvense)* were the dominant plant species on this shaly slope. A few small and widely scattered volunteer shrubs, including gray birch *(Betula populifolia)*, wild black cherry *(Prunus serotina)*, hawthorn *(Crataegus sp.)*, and blackberry *(Rubus sp.)* were also present. As there was little or no litter on the surface of the ground and the soil was too shaly for burrowing, no tunneling was possible. Apparently runways are not a requirement of the species.

Little is known regarding the food habits of this shrew, although there is every reason to suspect that they are similar to those of the other small shrews.

Females that had recently been lactating were noted on October 18, 19, 23, and 24, 1950. No placental scars were visible.

SPECIMENS TAKEN: 16—Berks 14, Dauphin 1, and Chester 1.

SHORT-TAILED SHREW

(Blarina brevicauda brevicauda)

DISTRIBUTION: Occurs in all counties; most universally distributed of our smaller mammals

HABITAT: Apparently exhibits little habitat preference.

NOTES: With few exceptions the short-tailed shrew was taken in all localities studied. While the species commonly occurs in such a variety of habitats as woods, meadows, and abandoned and cultivated fields, it seems to show a preference for moist situations, whether forested or non-forested. In addition to constructing its own subterranean runways through areas of friable soil or deep leaf-mold, the *Blarina* appropriates the runways of moles and burrowing mice. Traps placed in the runways of the Pine Mouse *(Pitymys pinetorum)* and the Eastern Mole *(Scalopus aquaticus)* very often produced *Blarina* before the desired species. This burrowing habit leads many people to believe this shrew is a "ground mole of some sort."

A voracious feeder, this, shrew is active both day and night, summer and winter, in its quest for a variety of invertebrates and vertebrates which include insects, larvae, earthworms, snails, and mice. It is not only capable of attacking and killing mice but will eat one of its own kind if given the opportunity. In an effort to placate a seemingly insatiable appetite the *Blarina* performs a definite service to the farmer by feeding on insects and larvae. In this respect they are equally as beneficial as our insectivorous song birds.

Most male specimens first show indications of apparent breeding condition between late February and early March. Gravid females become increasingly common after the middle of April. Each year there are several litters born from April to late September. These litters range in size from 4 to 8 individuals, with 6 being the more common number.

Specimens Taken: 456—Lebanon 26, Lancaster 65, Schuylkill 65, Chester 74, Northampton 9, Lehigh 14, Bucks 54, Berks 130, Montgomery 9, Delaware 10.

BATS

Distribution: There are eight species of bats known to occur in this region.

Notes: Big Brown Bat *(Eptesicus fuscus fuscus).* This is the most common and widely distributed of our bats. Most abundant about human habitations and farm buildings. A barn in Lebanon County contained an estimated 200 individuals.

Specimens Taken: 48—Lebanon 16, Berks 32.

Little Brown Bat *(Myotis lucifugus lucifugus).* The little brown bat is exceeded in abundance only by the big brown bat. While common about dwellings it seems to take more readily to caves than the latter species.

Specimens Taken: 8—Lebanon 3, Berks 5.

Pigmy Bat *(Pipistrellus subflavus subflavus).* Hibernating specimens were taken in Onyx Cave, Berks County, during late October. According to the owner, large numbers of bats formerly hibernated in this cave during the winter months, but within recent years mammal collectors have takn such a heavy toll that few bats remain.

Specimens Taken: 3—Berks 3.

Dr. Earl L. Poole (1932) records the following bats from the localities indicated:

Trouessart's Bat *(Myotis keenii septentrionalis)*; limestone caves of the Great Valley in Berks County.

Silver-Haired Bat *(Lasionycteris noctivagans)*; taken only during migration at Hopewell Dam, Berks County.

Northern Red Bat *(Lasiurus borealis borealis)*; apparently only a summer resident.

Seminole Bat *(Lasiurus seminolus)*; known from one specimen taken at Hopewell Dam, Berks County.

Hoary Bat *(Lasiurus cinereus)*; probably only a summer resident, taken in the neighborhood of Hopewell Dam, Berks County.

NON-GAME RODENTS

FISHER'S CHIPMUNK

(Tamias striatus fisheri)

Distribution: Known to occur in all counties of the region, but now quite local in distribution.

Habitat: Limited to habitats affording an abundance of fallen logs, rocks, stumps, and a moderate amount of overhead cover. This includes forested and semi-wooded areas as well as shrub-grown fencerows and rock piles.

Notes: The chipmunk was found to be quite local in its distribution, in all probability a temporary rather than a permanent condition. Areas that supported a fair population a few years ago are, at present, uninhabited, and the distinctive call and shrill, chirping whistle so characteristic of the species is rarely heard. As was found to be the case of the red squirrel, chipmunks have grown increasingly scarce during the past ten years. Only two sizeable concentrations were located, one in northern Lehigh County and the other in northern Berks County. In both instances the colonies were located near urban communities where the chipmunks were fed and cared for by the local residents.

The chipmunk makes its nest underground, burrowing into the earth at the foot of a stump or rock tangle. It is almost entirely terrestrial in habit, but occasionally climbs considerable heights to feed on the fruits of cherry and beech trees. This animal does not become excessively fat in the fall as do many of the other hibernating mammals. The time for hibernation varies greatly with the severity of the season, and occasional prolonged periods of warm weather during the winter may reactivate this mammal for a few days. October and March mark the average time for their winter disappearance and spring reappearance.

Food not consumed on the spot is carried in cheek pouches to underground caches where a quantity of mast, seeds, berries, and buds are stored. Insects, snails, and occasional small birds and mammals fall prey to this creature.

The mating season is usually in early spring and the young, 4 or 5 in number, are brought forth during the early summer. Apparently only one litter is raised annually.

Specimens Taken: 1—Lehigh 1.

EASTERN FLYING SQUIRREL

(Glaucomys volans volans)

DISTRIBUTION: Probably occurs in all counties of the region.

HABITAT: Natural cavities, deserted woodpecker holes, and dead snags, whether in forest or woodlot, appear to be favored retreats. This species appears to be more common in areas dominated by mast-producing trees.

NOTES: During the past two years flying squirrels were found to be common to fairly abundant only in the extensively forested regions of the Kittatinny range and the mountains to the north. South of the mountains this squirrel becomes increasingly scarce. It is apparently much scarcer today than formerly, due in part to a lack of suitable habitat. Being strictly nocturnal and subject to cyclic population trends, the flying squirrel is often overlooked by the untrained observer.

While flying squirrels are doubtlessly the most arboreal of our squirrels they very often appropriate bird boxes and garrets of houses and barns that adjoin wooded areas. Near Mt. Nebo, Lancaster County, 22 flying squirrels, one an albino, wintered in a tobacco shed that was situated at the edge of a large woodlot. The owner provided corn for these animals and in time they became reasonably tame. When spring came the squirrels moved into the woods, only to return again in the fall.

This attractive mammal has more or less an omnivorous appetite and, besides the nuts and vegetable food consumed by squirrels in general, is not averse to meat when available. Inasmuch as this squirrel is active throughout the winter it must store a quantity of food.

The number of young in the average litter is probably 4, ranging from 3 to 6. Breeding commences in later winter and parturition takes place from late March to early May. A female taken on March 21 contained 4 embryos of less than 1 mm. in size. Apparently two litters are produced during the course of the summer.

No northern flying squirrels *(Glaucomys sabrinus macrotis)* were taken, and it is doubtful whether the species occurs this far south in eastern Pennsylvania.

SPECIMENS TAKEN: 12—Lebanon 1, Schuylkill 4, Northampton 1, Lehigh 3, Berks 2, and Lancaster 1.

WHITE-FOOTED MOUSE

(Peromyscus leucopus noveboracensis)

DISTRIBUTION: Occurs in all of the counties of the region.

HABITAT: Prefers wooded or semi-wooded areas, although not uncommon in brush land and along fencerows. Exhibits a tendency to invade crop land during the winter months.

NOTES: This small mammal is one of the most abundant in the region. During the past two years, however, the population level seems to have been generally low throughout practically all of southeastern

Pennsylvania. In this study intensive trapping was conducted throughout the year and an annual increase in abundance was noted. From a seasonal low in early spring the population trend is upward until a high is reached in late fall. During the winter months there is a gradual decrease until the breeding begins again in the spring.

The white-footed or deer mouse is essentially a woods animal, but it commonly occurs in brush lands and meadows. While it is slightly more numerous in dry woods than in extremely moist woods, these mice frequent all but the wettest of situations. In this section of the state, overgrown fencerows that separate fallow fields are usually well populated. Heavily pastured woodlands, on the other hand, are avoided whenever possible.

Because of its nocturnal habits and ability to scamper quickly under the nearest stump or stone, it proves a more difficult target for predators than does the meadow mouse *(Microtus)*. Nevertheless, white-footed mice do act as a definite buffer species.

Warbles, the larvae of the bot flies *(Cuterebra)*, are commonly found in the inguinal region of this mouse during late August and September. As many as four warbles have been noted on a single specimen with apparently little physical effect on the host.

Nests are usually constructed of soft plant fibers and are secreted in hollow logs, abandoned bird nests, and in cavities in stumps and trees. This mouse seems to use the runways of other small mammals rather than to construct similar structures itself.

In addition to carrying all food to some protected spot before consuming it, the white-footed mouse also caches large quanities of food. Seeds of a wide variety of woody and herbaceous plants are regularly eaten along with such insects as grasshoppers, beetles, and crickets. The cached seeds of tulip poplar, wild black cherry, hemlock, and maple are often found beneath overhanging rocks and in crevices in stumps and logs.

While our records show that *Peromyscus* are quite prolific, producing a number of litters each season, we found no evidence to indicate that breeding takes place throughout the year. Pregnant females were noted from late March to early October. Litter sizes ranged in number from 1 to 7 with an average of 3.7. Whether breeding continues throughout the year during a population high could not be ascertained.

Specimens Taken: 1015—Lebanon 33, Lancaster 197, Schuylkill 96, Chester 218, Northampton 44, Lehigh 48, Bucks 98, Berks 245, Montgomery 12, Dauphin 18, Delaware 6.

PRAIRIE DEER MOUSE

(Peromyscus maniculatus bairdii)

Distribution: Taken only in Schuylkill County.

Habitat: Dry and exposed situations with a sparse ground cover of grasses and herbaceous weeds. Sparsely vegetated fields and road berms appear to be optimum for the species.

NOTES: A total of six specimens were collected during the survey and all of these were taken along the western border of the region. The eastward movement of the Prairie Deer Mouse, noted by the parties to the west of the Susquehanna River, has reached this area within relatively recent times. In all probability a few pioneers have been able to cross the Susquehanna River and are now multiplying east of that barrrier. Because the optimum habitat reaches to the Delaware River, subsequent migrations to the east will undoubtedly take place. The rapidity with which this movement takes place will depend largely on population during a general *Peromyscus* low.

The very few specimens of Prairie Deer Mice taken by this survey revealed little information regarding food and breeding habits.

SPECIMENS TAKEN: 6—Schuylkill 6.

ALLEGHENY WOOD RAT

(Neotoma magister)

DISTRIBUTION: The Allegheny Wood Rat is confined largely to the mountainous portions of Dauphin, Lebanon, Berks, Lehigh, and Northampton counties. A few isolated colonies exist along the rocky bluffs that parallel the east side of the Susquehanna River as far south as the Mason-Dixon Line.

HABITAT: Dry rocky cliffs and attendant talus slopes that are ramified by deep crevices and underground galleries.

NOTES: Because of its nocturnal habits and affinity for underground galleries and crevices deep within the rock slides of the mountainous regions, the wood rat's presence may go undetected, even in areas where it is quite common. One of the most easily recognizable characteristics of the wood rat is its habit of voiding fecal matter on the flat or slightly concave surfaces of the rocks. These accumulations of ovoid pellets sometimes cover a considerable area and are apparently the result of several individuals using the same defecating post. Wether this is a sanitary measure cannot be ascertained for certain, but these defecating posts are usually maintained at some distance from the nest sites.

The bulky nests of the wood rat are constructed of shredded plant fiber and generally placed in some inaccessible crevice deep in a jumble of boulders or on some ledge or shelf sheltered by an overhanging outcrop.

Usually in close proximity to these nest sites are heaps of miscellaneous material, including such plant items as shoots, and dried leaves, nuts, fleshy fruits, fungi, and lichens; listed among the foreign items in these collections are bottle caps, sardine cans, scraps of paper, feathers, and fox and raccoon dung. The latter items are apparently deposited on the storage heaps in fulfillment of the animals desire to collect and store objects. The wood rat's bill-of-fare is quite varied and includes a majority of the plants in the region. Much of this vegetation is cut, stored in a green condition, and "cured" under overhanging rocks.

During the breeding season, which our records indicate begins in late winter and continues well into the summer months, the males exhibit a marked enlargement and discoloration of the ventral dermal gland. Females give birth to a litter of three offspring on the average from March to September.

Specimens Taken: 10—Lancaster 2, Schuylkill 3, Lehigh 2, Berks 3.

RED-BACKED MOUSE

(Clethrionomys gapperi)

Distribution: Confined to the wooded mountainous portions of the region.

Habitat: The favorite haunts of this mouse are the cool shaded woods of the mountains where there is an abundance of moss-covered boulders and decaying logs. Optimum habitat appears to be cool rocky ravines with a ground cover of mosses and ferns.

Note: According to Dr. J. K. Doutt an examination of the specimens from southeastern Pennsylvania reveals that there are two resident subspecies; namely *Clethrionomys gapperi gapperi,* and *Clethrionomys gapperi rupicola.* Upon checking the localities from which these redbacks were taken we found that *ruplicola* is confined to the Kittatinny range and the mountains immediately to the north. A series of 18 specimens that were trapped in the South Mountains of Berks and Lancaster counties proved to be *gapperi.* Only one specimen of *gapperi* was identified as coming from the Kittatinny Mountain, 2 mi. NE Harrisburg, Dauphin County.

There is little apparent difference in the habitat requirements of the two subspecies. Both were found to be most common in rocky zones of the higher mountains where the forest cover was quite dense and deflected the direct rays of the sun. Black birch, yellow birch, and hemlock were usually found as associates in the forest composition of all localities producing red-backed mice. These mice are active both day and night, appropriating the burrows of moles and shrews rather than preparing extensive tunnel systems of their own. At no time during the survey did we find this mouse to be more than locally common.

A variety of herbaceous plants that occur in their forest habitat are readily consumed. Among the plant items noted in food caches were the nuts of mast-producing trees, berries, green buds, fern fronds, and succulent roots.

The breeding season apparently begins during the latter part of March or early April and continues well into November. Recent parturition was noted as late as November 15. Litters range in size from 2 to 6 individuals, with 5 being the average number.

Cleth. gapperi rupicola

Specimens Taken: 91—Lebanon 20, Schuylkill 32, Northampton 7, Lehigh 5, Berks 26.

Cleth. gapperi gapperi

Specimens Taken: 19—Dauphin 1, Berks 9, Lancaster 9.

PENNSYLVANIA MEADOW MOUSE

(Microtus pennsylvanicus pennsylvanicus)

DISTRIBUTION: Occurs throughout all counties of the region.

HABITAT: Largely confined to non-forested areas, and exhibits a seasonal preference for habitat. During the summer months moist sedge-grass meadows are preferred; dry, grassy uplands and crop lands are favored during the winter.

NOTES: With few local exceptions, this highly cyclic species seems to have been at a very low population level during our investigations throughout southeastern Pennsylvania. Trapping results and field observations indicate an annual population high occurs late in September and continues through the month of October, followed by a subsequent decline until early April. From April until the sudden eruption in September the population level appears to be rather static. Trapping results further indicate an annual movement from one habitat to another. The summer population exhibits a preference for sedge-grass meadows and sedge-cattail marshes. Only occasionally was this mouse taken in crop lands during the summer months. With the autumn increase in population there is a definite migration to permanent sod areas and well-drained meadows. This precludes a winter movement to dry grassy uplands and crop lands. Apparently this latter movement can be attributed to a search for food and the additional cover afforded by a layer of snow.

An interesting point about *Microtus* is the fact that occasionally a few individuals were taken in remote and isolated patches of their habitat, such as abandoned sawmill sites and beaver meadows well within large forested areas. From all indications this vole travels relatively long distances in search of new locations. This pioneering tendency is apparently closely related to population levels.

The food of *Microtus* has been studied by various naturalists and it suffices to say that in general the animal is a vegetarian. Such foods as grasses, sedges, rushes, and other herbaceous plants are readily consumed. Damage to shocked grain, orchard trees, and nursery stock is a common occurrence during the winter months. The destructive aspects of this mouse are partially overshadowed by the fact that it constitutes a prey species for such predators as the red fox, gray fox, weasel, mink, owl, and cat.

During the two winters of study a complete cessation in breeding was noted from late October to late March. Breeding commences in late March or early April and continues through October. Several litters are born each summer, with 5 being the average number in the litter.

SPECIMENS TAKEN: 332—Lebanon 10, Lancaster 45, Schuylkill 77, Chester 70, Northampton 20, Lehigh 14, Bucks 35, Berks 43, Dauphin 2, Delaware 16.

PINE MOUSE

(Pitymys pinetorum scalopsoides)

DISTRIBUTION: Probably occurs in all counties of the region.

HABITAT: Occupies a variety of situations which include dry fields, gardens, brush land, and wooded areas. Apparently limited to areas of light friable soil.

NOTES: At the present time pine mice are uncommon and very little evidence of their colonial nature was noted.

The pine mouse is well adapted for a fossorial life and largely confines its activities to tunneling beneath the surface of the ground. Only on rare occasions does this mouse venture any distance from the safety of its tunnels. Mole and meadow mouse burrows are also used as avenues of travel. Whether in forested or non-forested areas optimum habitat is closely related to soil conditions; light sandy alluvial soils are favored over all others.

The subterranean habits of the pine mouse account for its diet of fleshy roots and tubers. A food cache was uncovered containing the tubers of violets *(Viola sp.)*, Dutchman's breeches *(Dicentra cucullaria)*, squirrel corn *(Dicentra canadense)* and crinkle-root *(Dentaria sp.)*. Unidentifiable insect remains were also noted. When this vole invades orchard areas the resultant damage to young trees often attains great proportions. However, interviews with orchard managers failed to reveal any extensive damage within recent years.

Very little information was obtained concerning breeding habits. A female examined on May 25, 1950, contained 4 placental scars and was lactating; another taken March 28, 1951, contained 8, 5 mm., embryos.

SPECIMENS TAKEN: 14—Lancaster 2, Chester 8, Bucks 3, Berks 1.

HOUSE MOUSE

(Mus musculus musculus)

DISTRIBUTION: Occurs throughout the region.

HABITAT: Generally common about human habitations, barns, poultry houses, and granaries. Frequently found in waste and crop lands well removed from human settlements.

NOTES: The species is quite cosmopolitan and we have recorded it from a variety of situations which include weed-grown fencerows, meadows, tidal flats, cattail marshes, wasteland and crop land. In several localities house mice were equally as numerous as the native white-footed mice and meadow mice, with little apparent intolerance between the species.

Limited seasonal movements between crop lands and human habitations exhibited an intolerance for low temperatures and a general dependency upon man. With the end of the harvesting season and the beginning of cold weather there is a marked exodus from field to outbuilding and human habitation. This late fall movement is not complete however, as some rugged individuals maintain themselves throughout the winter in habitats that afford sufficient food and cover.

Pregnant females were recorded from early April to late September. Litters ranged from 2 to 8 individuals, although the average number is 5.

SPECIMENS TAKEN: 71—Lebanon 3, Lancaster 14, Schuylkill 8, Chester 17, Lehigh 1, Bucks 1, Berks 26, Delaware 1.

NORWAY RAT

(Rattus norvegicus)

DISTRIBUTION: Occurs throughout the region.

HABITAT: Found in a wide variety of habitats, particularly in those closely associated with man.

NOTES: The introduced Norway rat occurs wherever there is sufficient food and shelter, whether it be farm building, urban area, or tidal marsh. This noxious animal was taken quite frequently in farm areas and urban centers, but the largest single concentration in the entire region was noted along the tidal marshes of the Delaware River, from South Philadelphia to Marcus Hook. No check could be made on population densities; however, an incredible number of rat burrows riddled the reclamation dikes that criss-cross the area. Apparently there is a never-ending supply of edible flotsam being washed ashore with every high tide.

A limited amount of pioneering must take place, for on several occasions individuals were trapped in woodland and old beaver meadows miles removed from the nearest human habitation. On the lower Susquehanna River, Norway rats and wood rats were found to be occupying the same habitat.

SPECIMENS TAKEN: 8—Lancaster 2, Schuylkill 1, Delaware 5.

RICE RAT

(Oryzomys palustris palustris)

DISTRIBUTION: Possibly along the tidal flats of the Delaware River, between the Philadelphia International Airport and Marcus Hook.

HABITAT: Salt meadows, grassy tidal flats, and open brushland.

NOTES: There is considerable doubt as to whether this amphibious mammal occurs in southeastern Pennsylvania at the present time. Formerly there was apparently a considerable area of near-optimum habitat along the Delaware River and there is reason to believe that the species once occurred there; however, today most of the zone contiguous

to the river has been drained and reclaimed for industrial sites. Rice rats are known from localities in New Jersey, Delaware, and Maryland, none of which are too far removed from areas in Pennsylvania that were extensively trapped during the survey.

Dr. Robert K. Enders, Head of the Zoology Department, Swarthmore College, Swarthmore, Pennsylvania, reports that he noted *Oryzomys* skulls in owl pellets taken from a roost located eight miles north of the Delaware River. Unfortunately there is no way of telling whether these skeletal remains were brought in by migrating owls or whether they represent individuals taken along the Delaware.

If rice rats do occur in this region they would have to be commensal with the muskrats of the tidal areas.

MEADOW JUMPING MOUSE

(Zapus hudsonius hudsonius)
(Zapus hudsonius americana)

DISTRIBUTION: Occurs in all counties of the region.

HABITAT: Restricted to grass and weed-grown meadows and non-forested stream margins where the vegetation is thick and usually tangled.

NOTES: There are two subspecies of meadow jumping mouse in southeastern Pennsylvania. Both the southern form *(Zapus hudsonius americana)*, and the northern form *(Zapus hudsonius hudsonius)* were taken in limited numbers. *Zapus* appeared to be only locally common in such favored areas as grassy meadows and weed-grown stream margins. On two occasions we noted meadow jumping mice along the borders of dry woodlots where there was little or no ground cover. In all probability these mice represented wandering individuals moving from an area that had become dry in the course of the summer to another more suitable. There is considerable overlapping of the ranges of the two subspecies, and only near the extremities of their respective ranges do the southern and northern forms become dominant. Aside from the fact that the southern jumping mouse seems to be able to tolerate a slightly drier habitat than its northern relative there is no perceptible difference in habitat requirements.

Meadow jumping mice eat a variety of seeds and grasses as well as a wide assortment of insects. No food is stored, thus this mouse must accumulate a supply of excess fat to carry it through hibernation. Just prior to a six month's hibernation, commencing in October, *Zapus* become very fat and sluggish in their movements.

One pregnant female, taken on May 25, contained 7 embryos which were less than 1 mm. in size

Zapus hudsonius hudsonius

SPECIMENS TAKEN: 10—Lebanon 7, Berks 3.

Zapus hudsonius americana

SPECIMENS TAKEN: 5—Chester 2, Bucks 3.

WOODLAND JUMPING MOUSE

(Napaeozapus insignis insignis)

DISTRIBUTION: Apparently limited to the extensively wooded areas along the northern border of the region.

HABITAT: The woodland jumping mouse is largely confined to the cool, moist forests contiguous to mountain streams.

NOTES: This little denizen of the cool forests was extremely scarce, only three individuals being taken during the present study. All specimens were captured in traps set along the rocky edges of tumbling mountain streams where the overhanging banks afforded protection from above. In all productive trapping localities the stream banks were clothed by tangled growth of herbaceous plants and a mature forest of mixed conifers and hardwoods. While this rodent is known to frequent the same habitat as the red-backed mouse and the short-tailed shrew, at no time did we find it in localities inhabited by the meadow jumping mouse.

On two occasions *Napaeozapus* were flushed in small open glades where they were apparently feeding on the fallen blueberries that littered the ground. In addition, these mice readily consume other fleshy fruits, various seeds and insects. All food material is stored under the skin as surplus fat in preparation for the winter's hibernation that lasts from October to late April.

SPECIMENS TAKEN: 3—Berks 2, Schuylkill 1.

CHANGES IN MAMMAL POPULATIONS

In the two years of work in this region it was impossible to follow any one species through a complete cycle of abundance and scarcity; however, through our own observations and interviews with local residents, we were able to ascertain that some forms appeared to be increasing or decreasing in numbers. A summary of this information follows:

GAME ANIMALS

DEER: Population gradually increasing, especially in the woodlot-agricultural areas south of the Kittatinny Mountain.

RABBITS: Generally common, but surprisingly scarce in a number of apparently optimum areas.

GRAY SQUIRRELS: The most consistently common and widely distributed of our small game species.

WOODCHUCK: Common to locally abundant. Local population eruptions occasionally constitute a threat to agricultural lands.

FURBEARERS

Raccoon: Generally abundant and apparently near an all-time high.

Muskrat: With some local exceptions the muskrat seems to be able to withstand the heavy trapping pressure remarkably well. Apparently southeastern Pennsylvania was not as severely affected by the recent population low as the remainder of the State.

Skunk: The skunk seems to have recovered from the epizootic that swept the population in 1942, and is now on the increase.

Foxes: During the past ten years the gray fox has practically replaced the red fox in the southern border counties. A red-gray ratio of 4:1 in 1942 has practically reversed itself as of this writing. In general the number of foxes has greatly increased and in many localities this increase presents a definite predator problem.

Weasels: Common to relatively scarce. A gradual decline appears to have taken place within the past fifteen years.

Opossum: Common to locally abundant with a general increase in numbers.

Mink: For the region as a whole, the population is relatively static at a low level.

SMALL MAMMALS

Chipmunks and Red Squirrels: Scare to practically non-existent over most of the former range. This condition has become increasingly noticeable within the past twenty years.

Flying Squirrels: Fairly common only in areas of optimum habitat. Formerly this squirrel was generally common throughout the entire region.

Meadow Mouse *(Microtus):* The species exhibited marked seasonal fluctuation, but was only moderately common during the two-year study.

Deer Mouse *(Peromyscus):* Generally scarce in 1949-50, with scattered localities where they were common to abundant.

Smoky Shrew *(Sorex fumeus):* With the exception of a local eruption during the spring of 1950 the species was rather scarce.

Maryland Shrew *(Sorex cinereus fontinalis):* A definite population low during the winter of 1949-1950 followed by a sudden high during the winter of 1950-1951.

Short-Tailed Shrew *(Cryptotis parva parva):* The short-tailed shrew was taken in three localities, one of which was undergoing an increase in population.

CONCLUSIONS AND RECOMMENDATIONS

1. The application of various management practices to the problem created by an increasing deer herd and a decreasing food supply has produced few concrete results. It is the writers' opinion that this is due largely to the fact that no one practice has been employed for a sufficient period of time to ascertain its value. Therefore, it is recommended that the Pennsylvania Game Commission decide upon and carry out a specific management program for a period of not less than five years. The evaluation of any management practice stems from sufficient application.

2. It is the writers' opinion that the fox population should be drastically reduced, and the responsibility for this control measure should rest squarely upon the shoulders of the small game hunter and landowner. A concerted and coordinated effort on the part of regional sportsmens' organizations would greatly alleviate the excessive predator pressure on the small game species.

3. The Pennsylvania Game Commission should continue its investigation into the occurrence and ramifications of sarcoptic mange in the red fox population. Much of the needed information could be obtained easily by examining the fox skins which are probated for bounty.

4. Because large areas in southeastern Pennsylvania, notably the Lancaster Plain and the Great Valley, are intensively farmed with little or no provision made for small game, it is recommended that the Pennsylvania Game Commission inaugurate a program to purchase strips of standing corn and to lease streambanks, marshes, etc., for much-needed winter food and cover. It is believed that this practice would materially increase the winter carry-over of small game in this region.

5. It is recommended that the various sportsmen's organizations that yearly spend large sums of money for the importation of western rabbits divert these funds to rabbit habitat improvement. Rabbit management studies conducted by the Game Commission have conclusively proven that the key to practical rabbit management lies in compatible habitat, not the constant and ineffectual stocking of western importations.

6. The 1951 state-wide closed muskrat season was responsible for a population increase only in those areas depleted by heavy trapping pressure. In areas, such as southeastern Pennsylvania, where the population was high the closed season was of little benefit to the species. Here the loss to highway traffic and intraspecific strife was larger than it has been for years. From both a management and economic standpoint a sectional muskrat trapping season would be far more advantageous than the present state-wide program.

DATA AND REPORTS

The original data, field notes, and specimens upon which this report is based have been deposited in the Section of Mammals, Carnegie Museum, Pittsburgh, Pennsylvania.

This report was prepared by Harvey A. Roberts, Project Leader, and Robert C. Early, Assistant Project Leader.

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REPRODUCTIVE DATA

Date	*Embryos*	*Size (mm.)*	*Scars*	*Remarks*
1. *Peromyscus*				
July 26, 1949	4	1		Lactating
July 29, 1949	2	14		Lactating
Aug. 10, 1949	5	8		Lactating
Aug. 16, 1949	4	6		Lactating
Aug. 16, 1949	4	20		Lactating
Aug. 16, 1949			4	Lactating
Aug. 20, 1949	3	15		
Sept. 7, 1949	4	10		Lactating
Sept. 7, 1949	7	12		Lactating
Sept. 16, 1949			4	Lactating
Sept. 21, 1949			4	Lactating
Sept. 22, 1949	4	16		Lactating
Sept. 22, 1949	5	25		Lactating
Sept. 22, 1949			4	
Sept. 23, 1949			3	
Oct. 4, 1949			4	
Oct. 6, 1949			5	
Oct. 11, 1949			3	
Oct. 14. 1949			4	
Oct. 17, 1949			2	
Mar. 29, 1950	2	less than 1		
Apr. 20, 1950	4	13		
Apr. 21, 1950			4	Lactating
Apr. 26, 1950	3	7		
Apr. 27, 1950	2	1		
May 2, 1950	4	4		Lactating
May 3, 1950			5	Lactating
May 3, 1950	4	8		Lactating
May 10, 1950	3	22		Lactating
May 18, 1950			4	Lactating
May 19, 1950	4	16		Lactating
May 23, 1950	5	less than 1		Lactating
May 23, 1950	3	2		Lactating
May 23, 1950	4	10		Lactating
May 23, 1950	3	less than 1		
May 25, 1950			4	Lactating
May 26, 1950			4	
May 26, 1950			4	
May 26, 1950	3	less than 1		

Date	*Embryos*	*Size (mm.)*	*Scars*	*Remarks*
May 26, 1950	2	20		Lactating
June 9, 1950	4	8		Lactating
June 9, 1950			5	
June 9, 1950			3	
June 27, 1950	3	less than 1		Lactating
July 19, 1950	1	26		Lactating
July 20, 1950	4	4		Lactating
July 27, 1950	3	9		Lactating
Aug. 1, 1950			3	
Aug. 15, 1950			4	
Aug. 15, 1950	4	6		Lactating
Aug. 15, 1950			3	
Aug. 16, 1950	2	less than 1		
Aug. 17, 1950	4	23		Lactating
Aug. 22, 1950	4	8		Lactating
Aug. 30, 1950			2	Lactating
Aug. 30, 1950			2	Lactating
Aug. 31, 1950			4	Lactating
Sept. 6, 1950			4	Lactating
Sept. 7, 1950			3	Lactating
Sept. 7, 1950			4	Lactating
Sept. 7, 1950			2	Lactating
Sept. 7, 1950	3	3		Lactating
Sept. 7, 1950			4	
Sept. 7, 1950			4	
Sept. 7, 1950			4	
Sept. 8, 1950	6	2		Lactating
Sept. 13, 1950	4	7		Lactating
Sept. 13, 1950			5	Lactating
Sept. 13, 1950	3	less than 1		Lactating
Sept. 13, 1950	4	4		Lactating
Sept. 19, 1950	5	18		Lactating
Sept. 19, 1950	5	12		Lactating
Sept. 19, 1950	3	less than 1		Lactating
Sept. 19, 1950			5	Lactating
Sept. 20, 1950			6	Lactating
Sept. 20, 1950	5	6		Lactating
Sept. 20, 1950			6	Lactating
Sept. 20, 1950	5	6		Lactating
Sept. 20, 1950			3	Lactating
Sept. 20, 1950	5	12		Lactating

Date	*Embryos*	*Size (mm.)*	*Scars*	*Remarks*
Sept. 20, 1950			6	Lactating
Sept. 21, 1950	5	4		Lactating
Sept. 21, 1950			5	Lactating
Sept. 26, 1950	5	18		Lactating
Sept. 27, 1950	4	20		Lactating
Oct. 3, 1950			5	Lactating
Oct. 3, 1950			4	Lactating
Oct. 4, 1950			4	Lactating
Oct. 5, 1950			5	Lactating
Oct. 5, 1950	3	less than 1		Lactating
Oct. 6, 1950			5	Lactating
Oct. 18, 1950			4	Lactating
Oct. 25, 1950			2	Lactating
Oct. 25, 1950			2	Lactating
Oct. 26, 1950			4	Lactating
Mar. 27, 1951	5	17		Lactating
Apr. 3, 1951			4	Lactating
Apr. 9, 1951	4	14		Lactating
Apr. 11, 1951	5	14		Lactating
Apr. 19, 1951	3	2		
Apr. 20, 1951	4	less than 1		
Apr. 24, 1951	3	less than 1		

2. *Microtus*

Aug. 31, 1949	5	12		Lactating
Sept. 1, 1949			4	Lactating
Sept. 2, 1949	4	7		Lactating
Sept. 21, 1949	4	7		Lactating
Sept. 27, 1949	4	13		Lactating
Sept. 27, 1949			5	
Sept. 27, 1949	4	18		Lactating
Sept. 28, 1949	4	5		
Sept. 30, 1949			4	
Oct. 3, 1949			4	
Oct. 13, 1949			4	
Oct. 13, 1949			6	
Oct. 14, 1949			3	
Oct. 15, 1949			7	Lactating
Oct. 18, 1949			5	
Oct. 19, 1949	7	20		Lactating
Oct. 19, 1949			3	Lactating

Date	*Embryos*	*Size (mm.)*	*Scars*	*Remarks*
Oct. 20, 1949			3	Lactating
Oct. 26, 1949	5	22		Lactating
Nov. 10, 1949			4	
Apr. 18, 1950	5	5		
Apr. 25, 1950	4	less than 1		
Apr. 26, 1950	6	7		
Apr. 27, 1950	6	6		
May 25, 1950	5	23		Lactating
May 25, 1950	4	20		Lactating
May 25, 1950	5	19		Lactating
June 6, 1950	5	2		
June 6, 1950	8	10		Lactating
June 8, 1950	5	18		Lactating
June 8, 1950	6	10		Lactating
June 9, 1950	5	10		Lactating
July 12, 1950			5	
Aug. 1, 1950	5	9		
Aug. 4, 1950	4	24		Lactating
Aug. 9, 1950			5	Lactating
Aug. 11, 1950	5	12		Lactating
Aug. 23, 1950	4	8		Lactating
Aug. 24, 1950	3	27		Lactating
Sept. 1, 1950	6	2		
Sept. 12, 1950	6	6		
Sept. 12, 1950	7	9		Lactating
Sept. 22, 1950	7	26		Lactating
Sept. 26, 1950			4	
Sept. 28, 1950	4	13		Lactating
Oct. 20, 1950	4	15		Lactating
Oct. 23, 1950			3	
Oct. 23, 1950			4	
Apr. 18, 1951	5	less than 1		
Apr. 18, 1951	4	less than 1		
Apr. 20, 1951			7	
Apr. 20, 1951			7	
Apr. 20, 1951	5	10		
Apr. 20, 1951			5	
3. *Blarina*				
Aug. 5, 1949			3	Lactating
Aug. 10, 1949			2	Lactating
Aug. 30, 1949			3	Lactating
Apr. 19, 1950	5	less than 1		
Apr. 26, 1950	8	10		
May 18, 1950	6	17		Lactating

Date	*Embryos*	*Size (mm.)*	*Scars*	*Remarks*
May 18, 1950	6	3		
May 19, 1950	6	4		
June 2, 1950			6	Lactating
June 15, 1950	6	6		Lactating
June 16, 1950	6	6		Lactating
June 28, 1950			3	Lactating
July 27, 1950			3	Lactating
Aug. 9, 1950	6	10		Lactating
Aug. 9, 1950			6	Lactating
Aug. 23, 1950	4	18		Lactating
Sept. 6, 1950			6	Lactating
Oct. 3, 1950			6	Lactating
Oct. 23, 1950			3	
Apr. 9, 1951	6	2		
Apr. 12, 1951	4	4		
Apr. 17, 1951	5	13		
Apr. 18, 1951	6	2		
Apr. 18, 1951	8	3		
Apr. 18, 1951	6	7		
Apr. 20, 1951	1	23		Lactating
4. *Clethrionomys*				
Sept. 7, 1949			2	Lactating
Sept. 28, 1949	4	15		Lactating
Sept. 28, 1949	5	6		
Oct. 4, 1949	6	4		
Oct. 4, 1949			6	Lactating
Oct. 7, 1949			4	Lactating
Nov. 3, 1949			5	
Apr. 12, 1950	5	15		Lactating
Oct. 19, 1950			6	Lactating
Oct. 27, 1950			5	Lactating
Oct. 31, 1950			6	
Oct. 31, 1950	5	12		Lactating
Oct. 31, 1950			4	
Oct. 31, 1950			3	
Nov. 8, 1950			6	
Nov. 15, 1950			5	
5. *Sorex fumeus*				
May 23, 1950	6	9		Lactating
July 27, 1950			6	Lactating
Apr. 24, 1951	6	2		
Apr. 27, 1951	6	2		

Date	Embryos	Size (mm.)	Scars	Remarks
6. *Sorex cinereus*				
Sept. 26, 1950	4	7		
Sept. 26, 1950	4	4		
Mar. 27, 1951	6	less than 1		
Mar. 28, 1951	5	less than 1		
Mar. 30, 1951	6	5		
Apr. 17, 1951	4	2		
Apr. 18, 1951	6	8		
7. *Mus musculus*				
Sept. 21, 1949	8	11		Lactating
July 17, 1950			5	Lactating
Aug. 8, 1950			4	
Aug. 11, 1950	5	12		Lactating
Apr. 9, 1951	4	4		
Apr. 11, 1951	2	9		
Apr. 20, 1951	5	less than 1		
8. *Zapus*				
May 25, 1950	7	less than 1		
9. *Pitymys*				
May 25, 1950			4	Lactating
Mar. 28, 1951	3	5		
10. *Glaucomys volans*				
Mar. 21, 1950	4	less than 1		
11. *Cryptotis*				
Oct. 18, 1950			no visible scars	Recently Lactated
Oct. 18, 1950			no visible scars	Recently Lactated
Oct. 23, 1950			no visible scars	Recently Lactated
Oct. 24, 1950			no visible scars	Recently Lactated
12. *Neotoma*				
Nov. 6, 1950			3	Lactating
13. *Sciurus*				
Sept. 19, 1949			4	
Nov. 10, 1949			5	
Apr. 29, 1950			4	Lactating
14. *Tamias*				
Apr. 29, 1950			3	Lactating
15. *Scalopus*				
May 25, 1950			4	Lactating

FALL AND WINTER FOODS OF PREDATORY FURBEARING MAMMALS IN SOUTHEASTERN PENNSYLVANIA

(Percentage of Frequency of Occurrence)

	Opossum *(22)	*Skunk* (54)	*N. Y. Weasel* (15)	*Raccoon* (9)
Mammals:				
Cottontail	31.9	31.5	20.0	11.1
Woodchuck	4.6	—	—	—
Mice	9.1	5.5	60.0	—
Squirrels	9.1	1.8	6.7	—
Shrews-Moles	4.6	5.5	—	—
Miscellaneous[1]	13.6	16.7	—	—
Birds:				
Poultry	—	13.0	—	—
Miscellaneous[2]	36.4	40.8	6.7	22.2
Reptiles and Amphibians:				
Snakes	4.6	—	—	—
Frogs	—	—	6.7	—
Fish	—	—	6.7	—
Insects and Spiders	86.4	79.6	—	44.4
Crayfish	—	22.2	—	11.1
Snails	—	1.8	—	22.2
Carrion[3]	9.1	5.5	—	11.1
Vegetable Matter:				
Fleshy Fruits	63.6	42.6	—	33.3
Corn	18.2	7.5	—	66.7
Mast	—	—	—	11.1
Bean	22.6	1.8	—	—
Miscellaneous Seeds[4]	22.6	16.7	—	11.1

* Number of digestive tracts examined.
[1] Includes unidentifiable mammal remains plus a few identified species.
[2] Includes song birds and unidentifiable bird remains.
[3] Includes only definite instances of carrion: deer, dog, sheep, cow, etc.
[4] Includes miscellaneous seeds, grass, etc., which were apparently intentionally eaten.

THE SURVEY OF PENNSYLVANIA MAMMALS

Summary and Bibliography

Field work of the Survey of Pennsylvania Mammals was started in July 1946 and was completed in June 1951. In order to accomplish the objectives of the survey in the allotted time, the state was divided

into six sections and each assigned to a field party consisting of a Project Leader and an assistant. Upon completion of the field work each party submitted a final report summarizing the information obtained about the mammals of their respective sections.

The six projects were as follows:

Mammal survey of northwestern Pennsylvania. PR 20-R
Project Leader: Neil D. Richmond July 1946-Oct. 1948
Assistants: John J. Christian July 1946-May 1947
Clay L. Gifford May 1947-Oct. 1947
Woodrow W. Goodpaster Oct. 1947-March 1948
Harry R. Roslund March 1948-Oct. 1948

Mammal survey of southwestern Pennsylvania. PR 24-R
Project Leader: William C. Grimm July 1947-June 1949
Assistants: Woodrow W. Goodpaster Aug. 1947-Oct. 1947
Clay L. Gifford Oct. 1947-Nov. 1948
Harvey A. Roberts Nov. 1948-June 1949

Mammal survey of north central Pennsylvania. PR 37-R
Project Leader: Harry R. Roslund Nov. 1948-Oct. 1950
Assistants: Cole Wilde Feb. 1949-April 1950
Fritz Hilton May 1950-Aug. 1950

Mammal survey of south central Pennsylvania. PR 38-R
Project Leader: Clay L. Gifford Nov. 1947-Oct. 1950
Assistant: Ralph Whitebread Feb. 1949-Oct. 1950

Mammal survey of northeastern Pennsylvania. PR 42-R
Project Leader: William C. Grimm July 1949-June 1951
Assistants: Mark Rutledge July 1949-Oct. 1950
Ralph Whitebread Nov. 1950-June 1951

Mammal survey of southeastern Pennsylvania. PR 43-R
Project Leader: Harvey A. Roberts July 1949-June 1951
Assistant: Robert Early July 1949-June 1951

The six projects collected approximately 16,000 specimens of mammals from 420 localities in 62 of the 67 counties in Pennsylvania. In addition to the specimens collected, much information was obtained by observation and interviews, and was recorded in the field notes.

While examining the mammals many ectoparasites were observed and a large series, representing a wide variety of parasites from a wide range of hosts, was collected. This collection of ectoparasites was deposited in the Section of Insects and Spiders, Carnegie Museum. Some of this material has been studied and the results published, but much of it is still being studied. To a lesser extent, endoparasites were saved, especially those found in game and furbearing species; a part of this material has also been studied and the results published. Approximately 2,000 digestive tracts of mammals, mostly carnivores, were analyzed for information about food habits. Most of this information has been published.

Some idea of the scope of the survey may be obtained from the list of published papers that were based on, or referred to, material or data collected by this survey. The following bibliography is up-to-date as of July 1951. However, it should be kept in mind that the papers already published are but a beginning, since most of the material collected is still being studied and will be reported upon as the studies are completed.

Submitted by

FIELD SUPERVISOR, NEIL D. RICHMOND.

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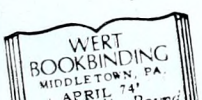
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